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Science and Art Gossip.

SCHOOL OF TELEGRAPHY.—On Monday, October 2, Mr. W. Lynd, a gentleman of several years' experience, will open a school of telegraphy for young ladies and gentlemen at Fair Bank, 13, Oaklands-grove, Uxbridge-road, W. Instruction is to be given in the various telegraphic systems used in the Postal Telegraph service, the apparatus for the purpose being made after the Post-Office pattern. While a course of instruction at this school will give an initial advantage to those of its pupils who join the permanent staff of the service, by far the greater gain will, we imagine, accrue to those who desire employment at the numerous sub-offices, which constitute a considerable portion of the postal system, and are destined, at the present rate of progress, to still further increase in number and importance.

CRYSTAL PALACE EXHIBITION.—The amount subscribed by gas companies towards the expenses of the special committee of the Gas Institute in connection with the forthcoming exhibition at the Crystal Palace now reaches about £4,000.

IN addition to the prizes already announced to be awarded at the forthcoming exhibition at the Aquarium, a £50 prize is to be awarded for the best electro-motor for stationary work, or for tram-car work, (*a*) absorbing ½ h.p., (*b*) absorbing 2½ h.p., (*c*) absorbing 5 h.p. The effective value of the receptor as economical for the transmission of power will be the chief point of contest—that is to say, if 1 h.p. is put in by strap indication at one end, the strap indication of the work done at the other end will be measured, and the comparison thus made.

EDISON *v.* SWAN.—At the meeting of the Swan United Electric Light Company held last week, the chairman stated, with reference to the threatened litigation between Edison's Company and theirs, that there could be no doubt as to the separate character of the inventions, and that he thought it not unlikely that the companies would join forces rather than fight each other.

MINERAL PRODUCTIONS IN EUROPE.—The French Minister of Public Works has just issued the annual statistics of mineral industry. We extract therefrom the figures below showing the mineral production of the principal countries in 1880. The total amount is 380,657,000 tons, representing a value of about £250,759,467. France, 23,257,657 tons; England, 171,061,476 tons; Germany, 59,680,754 tons; Belgium, 17,172,749 tons; Austria, 14,216,282 tons; Hungary, 2,281,373 tons; Italy, 1,107,624 tons; Spain, 2,584,361 tons. These amounts include combustible minerals, iron, lead, copper, zinc, sulphur, tin, manganese, antimony, marine salt, and rock salt.

THE following table, which has been prepared by the French Ministry of Public Works, gives the railway mileage of the various countries of Europe and the United States up to the end of last year, with the number of miles constructed in that year, and the population per mile:—

	Total.	Built in 1881.	Population per Mile.
Germany	21,313	331	2,154
Great Britain	18,157	164	1,939
France	17,134	895	2,170
Russia	14,745	3	5,586
Austria-Hungary	11,880	262	3,200
Italy	5,450	109	5,321
Spain	4,869	176	3,492
Sweden & Norway	4,616	273	1,408
Belgium	2,561	48	2,203
Switzerland	1,557	22	1,831
Holland	1,426	83	2,835
Denmark	1,053	25	1,919
Roumania	916	56	5,860
Turkey	866	—	2,891
Portugal	757	8	5,870
Greece	6	—	28,000
Total	107,306	2,455	3,168
United States	104,813	9,358	502

It appears from this that the United States mileage was only 2,493 less than the total of all Europe, and at the present time it exceeds it, as the former country has built about 6,000 miles this year, whereas Europe has not exceeded 1,500. The difference in the number of persons per mile in the two cases is also very great, Europe taking six times as many persons to support a mile of railway as the States, and can only be accounted for by the fact that American railways are constructed much cheaper than the European ones.

ACCORDING to the census reports, the population of the United States in 1880 was 50,155,783, of whom 36,843,291 were whites native born, and 6,679,943 were whites foreign born; the coloured population being 6,632,549. Of foreign born whites, 2,772,169 were natives of the United Kingdom, 1,966,742 Germans, 717,084 British-Americans, 194,337 Norwegians, 181,729 Swedes, 106,971 French, 104,541 Chinese.

"THE Americans," says Mr. G. Phillips Bevan, "who were to a certain extent influenced by the representations of that colossal scoundrel Kearney, in California, were not a little surprised when the figures of the census revealed the presence of the Chinese in very much smaller numbers than were stated and believed. So vague, indeed, was the previous knowledge, that even our Consul in San Francisco reported that in 1876 there were over 150,000 Chinese in the States, which numbers, during the agitation of the next year, were conveniently increased to 200,000 in California alone. The census tables of 1880 showed that the whole number of Chinese in the States was only 105,717; and although, from climatic and labour reasons, the percentage in a few of the States was rather large, the total proportion of 105,717 Chinese to the 51,000,000 inhabitants of the United States was so absurd, that the Chinese bugbear collapsed at once, to the shame of many who had taken part in the agitation."

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Infection at Seaside Lodgings.—We are continually receiving cuttings from newspapers and communications of various kinds, pointing out—in too many instances very painfully illustrating—the perils of infection which lurk in seaside lodgings to which the weakly or jaded resort for rest and health. There is an irony in the fate which makes these places notorious as centres for the propagation of disease. It is not easy to suggest a remedy, because those who live by letting lodgings regard their visitors as fair game at any risk. If a lodger contracts fever or diphtheria, and dies or is removed one week, the bill "To Let" will be up again the next week. It has been repeatedly suggested that there should be a systematic registration and inspection of lodgings, but apparently the time has not arrived for the need of such a measure to be publicly felt. Perhaps, when the many cases which are now scattered, and therefore overlooked, come to be collected and reported *en masse*, public opinion may be stirred in the interests of self preservation and common sense.—*Lancet.*

Indians as Workmen.—The popular theory that the Indian cannot be made to work is not altogether unfounded. It by no means follows, however, that he cannot be induced to work, and work well, when removed from his native surroundings and supplied with the proper incentives. The Indians in the industrial schools at Hampton, Va., and at Carlisle, Pa., have shown a readiness to acquire trades and a capacity to learn to handle tools skilfully, that must stagger the prejudices of those who have adopted the frontier creed that the only useful Indian is a dead Indian. At the recent public exercises at Carlisle, a Plains Indian was the proud, though seemingly stolid, exhibitor of a waggon built entirely by himself, a piece of work that older mechanics might not have been ashamed of. The Springfield *Republican* says that there are now on exhibition in Boston samples of shoes and harnesses made at Hampton Institute, which both in finish and serviceableness are able, in the opinion of competent inspectors, to compete successfully with the products of regular workmen. The shoes are part of a contract for two thousand pairs which the Government gave to the Superintendent of the Institute, General Armstrong, last spring. The Government has also ordered seventy-five sets of double-plough harnesses. General Armstrong is confident that within five years, as the hundred Indians at Hampton, the three hundred at Carlisle, and others under instruction elsewhere, become masters of the craft, all the shoes and harnesses needed for the plains, can be made by Indian young men at home.

The largest strap for the transmission of motive power in the world was recently completed at Berlin. Its width is 160 centimètres, of about 6 feet 3 inches, and its weight a ton and a half. As many as 200 of the largest and heaviest ox-hides had to be used in making this gigantic strap. It is intended for a starch manufactory in Germany, where it is to transmit a motive power equal to 500 horses.

Medical men have always differed as to whether the best treatment of frozen persons was by a gradual or rapid application of heat. To settle the matter, Laptchinkski has made a series of very careful experiments upon dogs, with the following results: Of twenty animals treated by the method of gradual resuscitation in a cold room, fourteen perished; of twenty placed at once in a warm apartment, eight died; while of twenty immediately put into a hot bath, all recovered.

The largest locomotive ever built has just been completed at Paterson, N.J., and is one of twenty-five ordered by the Central Pacific Railroad. Its weight without the tender is sixty-two tons. The size of the cylinders is twenty by thirty inches. These engines have eight drivers and a four-wheeled truck.

Statistics of the Postal Union.—The following statistics for 1881 have been issued by the central authority of the Postal Union in Switzerland. During the year the Union was reinforced by the accession of Chili, Columbia, the Little Antilles, Grenada, St. Lucia, Tobago, the Turks Islands, Barbadoes, St. Vincent, Guatemala, Haiti, and Paraguay, while, since the commencement of the present year, Hawai and Nicaragua have also joined. In round numbers, the amount of business carried on during 1881 included the transmission of 3,866,000,000 letters, 649,000,000 postal cards, 3,000,000 cards with paid answers, 1,983,000,000 newspapers, 1,023,000,000 printed packets, 64,000,000 patterns, 98,000,000 small parcels. The post office orders granted were 95,000,000, representing a value of 8,045,000,000 f. Daily throughout the globe, the Postal Union expedites upwards of 13,000,000 letters and post-cards, without counting printed matter, while the distribution of each year includes 3,448,000,000 letters in Europe, 1,246,000,000 in America, 76,000,000 in Asia, 36,000,000 in Australia, and 11,000,000 in Africa.

The Velocity of Light.—Preparations are nearly completed at the Case School of Applied Sciences, Cleveland, Ohio, for a reinvestigation of the velocity of light, by Professor A. A. Michelson, late of the Naval Academy at Annapolis. The velocity found (186,380 miles a second) differed slightly from that obtained by M. Cornu at the observatory at Paris in 1874, and also, it is said, from that obtained more recently by Professor Newcomb at Washington. The results of the last-named observations have not been published. Mr. Michelson has, accordingly, been requested to repeat his experiments, money for the purpose, about $1,200, having been promised from the Bache scientific fund. The Cleveland *Leader* says that two small buildings have been erected for the experiments on the grounds of the Case School. The larger of the two, 16 × 45 ft., contains the chief apparatus. Two thousand feet west of it is a smaller building containing a stationary mirror. In the experiments the light traverses the space between the buildings and back again to the apparatus, by whose movement data are obtained upon which the velocity of the light is measured.

The Area of Modern States.—Some interesting facts may be gleaned as to the relative size, according to area, of the various European and American States. The largest State in the civilised world is Texas, which boasts an area of 274,356 square miles; the smallest is the little State of Monaco in Europe, which has only an area of six square miles. The Austrian Empire contains 240,943 square miles; the German Empire, 212,091; France, 204,091; Spain, 177,781; Sweden, 168,042; California, 157,801; Dakota, 150,932; territory of Montana, 143,776; Norway, 122,280; New Mexico, 121,201; Great Britain and Ireland, 120,879; Italy, 114,296; Arizona, 113,916; Nevada, 112,090; Colorado, 104,500; territory of Wyoming, 97,883; Oregon, 95,274; territory of Idaho, 86,294; territory of Utah, 84,476; Minnesota, 83,531; Kansas, 80,891; Nebraska, 75,995; territory of Washington, 69,994; Indian territory, 68,991; Missouri, 65,350; Turkey in Europe, 62,028; then come a number of other American States, after which are Roumania, 45,642; Bosnia and Herzegovina, 28,125; Bulgaria, 24,360; Servia, 20,850; Netherlands, 20,527; Greece, 19,941; Switzerland, 15,235; Denmark, 14,553; Eastern Roumelia, 13,500; Belgium, 11,373; and Montenegro, 1,770.

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MONKSHOOD.

By Grant Allen.

TO look at these queer, irregular blue flowers, growing on a long and handsome spike in the old-fashioned garden border, nobody would ever dream of saying that they were in reality altered and modified buttercups. And yet that is just what they really are, with all the marks of their curious pedigree still clearly impressed upon their very form. Pull one of the blue blossoms off, and pick it carefully to pieces, and you will see how strangely and profoundly it has been distorted by insect selection. Monkshood is most essentially a bee-flower, and in examining it we see the results of bee action plainly set forth in every organ. If we pick a common meadow buttercup for comparison with it, we shall be able to see exactly wherein the two flowers differ, as well as why the one has gained an advantage in the struggle for existence over the other.

The outside whorl of the buttercup consists, of course, of five separate greenish sepals, which together make up its calyx. Inside the sepals come the five golden petals composing the cup-shaped corolla; and inside the petals, again, come the numerous stamens, and the equally numerous carpels or unripe fruits, each containing a single, solitary little seed. Moreover, all these parts are regularly and symmetrically arranged round a common centre, so as to form a series of concentric whorls. But when we look at the monkshood, we see no such simple and orderly arrangement in its architectural plan. At first sight, we recognise no distinct sepals or petals; and the coloured organs that take their place are very irregular in shape, and disposed in an unsymmetrical fashion—or rather, to speak more correctly, their symmetry is not radial, but bilateral. When we begin to pull our blue blossom to pieces, however, we gradually recognise the various parts of which it is composed. First of all come five sepals, not greenish as in the buttercup, but bright blue; and not all alike, but specially modified to fulfil their separate functions. The uppermost sepal of all is helmet-shaped, and it forms the curious cowl which gained the plant its suggestive name from our mediæval ancestors. The two side sepals, to right and left, are flatter and straighter, but very broad, while the two lowest of all are comparatively small and narrow. The whole five are bright blue in colour. Pull off these petal-like sepals, and you come to the real petals beneath them. At first you can hardly find them at all; you see only two long blue horns, covered till now by the helmet-shaped upper sepal or cowl, and each with a queer cup-like sac at its extremity, containing a small drop of clear fluid. That fluid is honey, but I should advise you to be careful in tasting it not to bite off any of the flower, for monkshood is the plant from which we get the now famous poison, aconitine; and a very little of it goes a long way. Unlike as they are to the familiar yellow petals of the buttercup, one can still gather from their position that the two long horns are really petals. But where are the three others? Well, you must look rather close to find them, and perhaps even then you won't succeed after all; for sometimes the three lower petals have disappeared altogether, being suppressed by the plant, as of no further use to it. In this particular specimen, however, they still survive as mere relics or rudiments, three little narrow blue blades, not nearly as big as a gnat's wing, placed alternately to the lower sepals. As for the stamens, they are still present about as numerously as in the buttercup; whereas the carpels, or fruit-pieces, are reduced to three only, which in the ripe seed-vessels here on the lower and older part of the spike grow into long pods or follicles, each containing several seeds.

Thus, then, the flower of monkshood agrees fundamentally with the flower of the buttercup; while, at the same time, it has undergone some very singular and suggestive modifications. In both there are five sepals; but in the buttercup all five are alike, and all five are greenish; whereas in the monkshood they have acquired different shapes, exactly fitting them to the bee's body, and they have become blue, because blue is the favourite colour of bees. Again, in both there are five petals; but in the buttercup all five are similar and yellow, and all five secrete a drop of honey at the base; whereas in the monkshood two of them have become long and narrow specialised nectaries, while the other three, being no longer needed, have grown obsolete or nearly so. Once more, the stamens remain the same; but the carpels have been immensely reduced in number, at the same time that the complement of seeds in each has been greatly increased by way of compensation.

Well, how are we to account for these peculiar modifications? Entirely by the action of the fertilising bees. The secret of the monkshood depends, in the first place, upon the fact that its flowers are clustered into a spike, instead of growing in solitary isolation at the end of the stem, as in the common buttercups. Now Mr. Herbert Spencer has pointed out that solitary terminal flowers are always radially symmetrical, and never one-sided, because the conditions are the same all round, and the visiting insects can light upon them equally from every side. But flowers which grow sideways from a spike are very apt to become bilaterally symmetrical; indeed, whenever they are not so, one can always give an easy explanation of their deviation from the rule. Probably the blossoms of the monkshood began by arranging themselves in a long and handsome spike, so as more readily to attract the eyes of insects; and that was the real starting point of all their subsequent modifications. Or, to put the same thing more literally, those monkshoods which happened to grow spike-wise succeeded best in attracting the bees, and therefore were most often fertilised in the proper manner. Next, we may suppose, the large green sepals, being much exposed to view, began to acquire a blueish tinge, as all the upper parts of highly developed plants are apt to do; and the bluer they became, the more conspicuous they looked, and therefore the better they got on in competition with their neighbours, especially since bees are particularly fond of blue. As each bee would necessarily light on the middle or lower portion of the flower, he would begin by extracting the honey from the two upper petals; but it would be rather awkward for him to turn round, head downward, and suck the nectaries of the three bottom ones. Hence, in course of time, especially after the flower began to acquire its present shape, the two top petals became specialised as nectaries, while the three lower ones gradually atrophied, since the coloured sepals had practically usurped their attractive function. But as the flower can only succeed by being fertilised, all these changes must have been really subordinate to the great change which was simultaneously going on in the mechanism for ensuring fertilisation. Slowly the blossoms altered to the bilateral shape—they adapted themselves by the bee's unconscious selection to the insect's form. The uppermost sepal grew into the hood, so arranged that the bee must get under it in order to reach the long nectaries containing their copious store of honey. At the same time the bee must brush against the stamens, and cover his breast with a stock of adhesive pollen-grains. When he flies away to the next flower he carries the

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pollen with him; and as he rifles the nectaries in the second blossom, he both deposits pollen from the last plant upon the sensitive surface of the carpels in this, and also collects a fresh lot of pollen to fertilize whatever other flower he may next favour with a call. The increased certainty of fertilisation thus obtained enables the plant to dispense with some of the extra carpels which its buttercup ancestors once possessed; and by lessening the number to three, it manages to get the whole set impregnated at a single visit. But, as three seeds would be a small number to depend upon in a world of overstocked markets and adverse chances, it makes up for the diminution of its carpels by largely increasing the stock of seeds in each.

Thus the whole shape and arrangement of the monkshood bear distinct reference to the habits and tastes of the fertilising bees. It is a mountain plant by origin, belonging to a tribe which took its rise among the great central chains of Europe and Asia, and these Alpine races are usually highly developed in adaptation to insect fertilisation, because they depend more absolutely upon a few upland species than do the eclectic flowers of the plains, which may be impregnated hap-hazard by a dozen different flies, or moths, or beetles. We can still dimly trace many of the links which connect it with very simple and primitive buttercups, if not directly, at least by the analogy of other plants. For all the buttercup tribe show us regular gradations in the same direction. The simplest kinds are round, yellow, and many-carpelled, like the buttercups. Then those species which display their sepals largely have dwarfed petals, like hellebore and globe-flower, or have lost them altogether, like marsh-marigold, which trusts entirely for colour display to its big golden calyx. The still higher anemones have the sepals white, red, or blue; and the very advanced columbine has all the petals spurred, and developed into nectaries, like those of monkshood. But columbine still keeps to single terminal flowers, so that here the five petals remain regular and circularly symmetrical, though the carpels are reduced to five. Fancy a number of such columbine flowers crowded together on a spike, however, and you can readily picture to yourself by rough analogy the origin of monkshood. The sepals would now become the most conspicuous part; the two upper petals would alone be useful in insuring fertilisation, and the lower ones would soon shrivel away from pure disuse. The development of the hood, and the lengthening of the upper petals, would easily follow by insect selection. It is a significant fact that our only other spiked buttercup, the larkspur, has equally irregular and bilateral flowers, though its honey is concealed in a long spur formed by the petals, and accessible to but one English insect, the humble bee.

VENUS NEARING TRANSIT.

By the Editor.

(*Continued from page 275.*)

IN the first part of this article, I have given an account of the various changes of appearance presented by the beautiful star which sometimes shines as Hesperus, the star of evening, and sometimes as Lucifer, the morning star. Let us now consider what this star really is, so far, at least, as we can learn by using telescopes and other instruments.

Venus has, in the first place, been measured, and we find that she is a globe nearly as large as the earth. Like the earth, she travels round and round the sun continually, but not in the same time as the earth. The earth goes round the sun once in twelve months, while Venus goes round once in about seven-and-a-half months; so that *her* year, the time in which the seasons run through their changes, is four-and-a-half months less than ours. If Venus has four seasons like ours, — spring, summer, autumn, and winter,—each of these seasons lasts eight weeks. Venus also, like our earth, turns on her axis, and so has night and day as we have. Her day is not quite so long as ours, but the difference—about twenty-five minutes—is not very important.

So far there is nothing in what we have learned about Venus which does not agree well with the idea that the planet is a world like our earth, where people like ourselves might live very comfortably. For it would not matter much to us, probably, if the year were shortened by four or five months, and the day by half-an-hour—supposing always that trees and vegetables were so made that they could thrive under the change. In fact, if anyone leaves the temperate regions to visit the tropics, he has to undergo a greater change. For in England, and throughout the United States, the seasons change from the heat of summer to the cold of winter, and back again to the heat of summer, in twelve months; but at the equator, the greatest heat occurs in spring and autumn, or at intervals of only six months. So far as the length of the year is concerned, an American or an Englishman could very well bear the change to the temperate zone of Venus, where the interval between the successive seasons of greatest heat amounts to seven-and-a-half months.

But when we consider some other points, we see that Venus, beautiful though she looks, would not be a comfortable home for us. Venus is much nearer to the sun—the great fire of the solar system—than our earth is. She receives, then, much more heat from him. In fact, it is easily calculated that if our earth were set travelling on the path of Venus, we should receive almost exactly twice as much heat from the sun as we do at present. This would be unbearable, except, perhaps, in the Polar regions; and even there the summer, with that tremendous sun above the horizon all through the twenty-four hours, would be scarcely bearable. Besides, what a contrast between the hot Polar summer and the cold Polar winter, when for weeks together the sun would not be seen at all. Altogether, this earth would be a miserable home for us if her path were as close to the sun as that of Venus.

We see, then, that either there must be some peculiarities about Venus which prevent the sun from heating people there as he would certainly heat us if our home were there, or else the creatures which live on Venus must be different from ourselves and the other animal inhabitants of our earth. Unfortunately, we cannot make telescopes large enough to show us what is going on upon that planet, and there is no reason for hoping that such telescopes can ever be made. What we know, however, about the planet's condition does not seem to show that creatures living there would be more comfortable than we should be if the earth were put where Venus is. Just the contrary, so far as we can judge. The seasons on our earth are caused by the fact that she turns on a slanted axis. If her axis were upright, there would be no seasons; if it were more slanted, the contrast between summer and winter would be greater. Now Venus has her axis much more slanted than the earth's, so that her seasons must be very marked indeed. Thus the heat of her summer weather must be even more terrible than if her globe were inclined like the earth's.

But there is yet another point to be noticed. On the upper slopes of lofty mountains, there is snow all the year round, even in the torrid zone. That is because the air up there is so rare that it does not act like the denser air

lower down, which is a sort of clothing for the earth, keeping the heat from escaping. Now if the air of Venus were very rare, something of the same sort might happen on that planet. Just as people who live in torrid zones seek the high mountain slopes in the hottest seasons of the year, and find there a temperate climate, so the inhabitants of Venus might find it possible to bear the sun's intense heat if the air of the planet were rare like that above the snow-line in our mountain regions.

But it seems that, on the contrary, the air of Venus is even denser than ours. And it seems also to be a moist air, which is just the kind of air that keeps the heat in most. The air of Venus is, in fact, so dense and moist that the planet would be very uncomfortable (quite apart from the intense heat) for creatures like ourselves.

The density of the air of Venus has been shown in several ways. Perhaps the most satisfactory proof is that which was obtained during the last transit of Venus across the sun's face, on December 9, 1874.

On that occasion, when the planet traversed such a path as is shown in Fig. 4, a phenomenon of great physical interest and importance was observed.

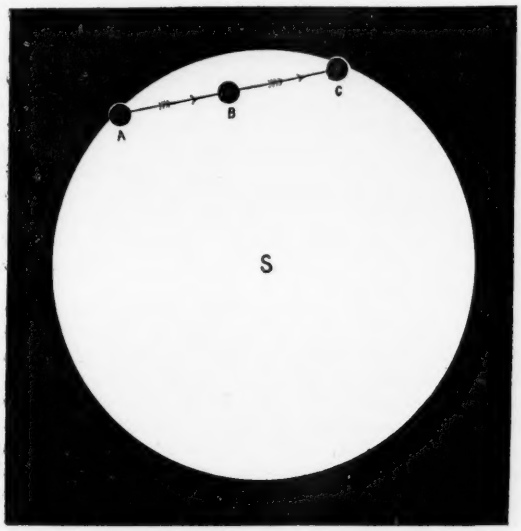

Fig. 4.

When the planet was at A, entering on the sun's face, a bright arc of light was seen round the part of the planet which had not yet entered upon the sun's face. This arc was not a mere faint light, but strong sunlight, as bright as that derived directly from the sun's disc. When the planet was at C, a similar arc of light was seen, as shown in Fig. 4.

Fig. 5.

There is only one way in which this arc of light can be accounted for, and that is by the action of air upon Venus bending the sun's rays, as shown in Fig. 5, so that the sun is seen *round the corner*. Our air shows us the sun in this way, when he would be quite out of sight if there were no air; for when we see the sun's disc just touching the horizon, it is the air which really brings him into view, by bending his rays round the curved surface of the earth.

So we are quite certain that there is air of some kind on Venus. And we can even tell how much there is. Professor Lyman, of Yale College, America, has made observations of this kind (not exactly the same as are illustrated in Fig. 5, but depending upon the same bending power of the air on rays of light); and from what he has seen, it appears that the air on Venus is about twice as dense (at the planet's surface) as the air on the earth.

Remembering that the sunlight has passed through this air, we can understand that the light which comes to us as in Fig. 5 may tell us what sort of air it has passed through. The spectroscope can tell as certainly—though the observation is, of course, more delicate—that it has passed through the vapour of water in the air of Venus, as the rainband spectroscope on our own earth can tell us of the presence of aqueous vapours in our air. That is what astronomers learnt in December, 1874, when the globe of Venus was passing, as in Fig. 4, between our earth and the sun.

There cannot be moisture in the air of a planet unless there are seas and oceans on the planet's surface. No doubt, then, Venus has her continents and oceans, her islands and promontories, and inland seas and lakes, very much as our earth has. Then there must be rivers on the land, and currents in the ocean; there must be clouds and rain, wind and storm, thunder and lightning, and perhaps snow and hail.

Whether the planet is an inhabited world or not, it would be difficult to say. Perhaps it is a world getting ready for use as a home for living creatures. Most physicists believe that the sun is gradually parting with his heat. If, millions of years hence, the sun should only give out half as much heat as he does, Venus would be as comfortable a place to live in as our earth is now. But at present it may safely be said that if Venus is inhabited, it must be by creatures very different from those inhabiting the earth.

(*To be continued.*)

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

By Miss Amelia B. Edwards.

X.—PA-RAMESES.

OUR first step when seeking to identify the sites of Pithom and Raamses is to collect such scattered mention of cities bearing these famous names as may be gathered from ancient Egyptian writings. These references are, perhaps, more numerous than might be expected.

The name of Pa-Rameses occurs much more frequently than the name of Pa-Tûm. We meet with it in several documents of contemporary date (that is to say, in papyri of the time of Rameses II. and his immediate successors), and also in one important lapidary, or stone-cut, inscription. This last is found in the great rock-cut Temple at Aboo-Simbel in Nubia, and covers a large tablet built up between two of

the Osiride columns in the first Hall. The text* consists of 37 lines of sculptured hieroglyphs, and it purports to be an address from the God Pthah Tatunen to Rameses II., followed by the King's reply to the same. The speech of the God is conceived in the most florid style of oriental compliment. The King is his son, made after his own likeness; an eternal King; a prince for ever, with "limbs made in electrum, with bones of brass, with arms of iron." There is plenty wheresoever he bends his footsteps. The Nile is always high for him; the harvest always abundant; the fishing always plentiful. To him his divine father grants success in all his works, enabling him (in allusion to the enormous Colossi seated in front of the temple) "to cut the mountains into statues immense, gigantic, everlasting." He then goes on to say:—"Thou hast built a great residence to fortify the border of the land, the city of Rameses (Pa-Rameses); it is established on the earth like the four pillars of the sky. Thou hast constructed within it a royal Abode, where festivals are celebrated to thee as is done for me within." This last "within" does not mean within the walls of the same "Abode," or temple, in which Rameses was himself worshipped as a divinity. It is used in the sense of the inner, or inland, country, as opposed to the frontier country; and means Memphis, which was the great centre of the cult of Pthah. The topographical and strategical allusions in the above lines are very valuable. They show that the Pa-Rameses in question was a *new* city; that it was a fortified place upon the borders; and that it was dedicated to the worship of the Pharaoh in his divine character. It thus fulfills all the conditions necessary to its identification with the "Raamses" of the Bible.

The contemporary papyri in which we find mention of a city (or possibly of various cities) called "Pa-Rameses" are chiefly letters, or copies of letters; some being the intimate correspondence of private persons; others being business letters on the most matter-of-fact subjects; while some, in a more ornate style, would seem to have been transcribed either as exercises in penmanship, or as specimens of elegant composition, like the epistles in "The Polite Letter-writer" of our grand-parents. That such documents, written upon a material so perishable as papyrus, should have survived the wreck of ages, is at least as wonderful as that the language in which they are expressed, and the crabbed script in which that language is written, should be as intelligible, and as legible, to Egyptian scholars of this day as they were to those who wrote and read them three-and-thirty centuries ago. And if in these pages of fugitive correspondence we indeed find passing mention of one, or both, of those "treasure-cities" which were the scene of the oppression of the Hebrews, the marvel culminates. These letters, found buried with mummies in their coffins, or in earthen pots among the ruins of ancient dwellings, or in hiding-places excavated in the rock, have been bought up from time to time by travellers in Egypt, and have so been re-sold to various European Museums. Some with which we are now especially concerned are among the famous "Anastasi" papyri of the British Museum, while others form part of a very large and curious document called "The Great Hieratic Papyrus of Bologna." The "Anastasi papyri" (so called because purchased from M. Anastasi by the trustees of the British Museum) consist of a collection of letters, copies of letters, miscellaneous memoranda, minutes on judicial matters, treatises written apparently for educational purposes, and the like. The Great Hieratic Papyrus of Bologna (which is in one piece, and measures nearly two-yards-and-a-half in length) contains transcripts of sixteen letters by various scribes, mostly in the service of Menephthah, the son and successor of Rameses II. It is dated by the copyist in the eighth year of that Pharaoh. The allusions to Pa-Rameses which occur in these letters are casual and unimportant. The scribe Mahoo of the Royal Workshops, writing to the scribe Pinem, cautions this latter to pay particular attention to the building of certain chariots for the superintendent of Panegyries, adding "As I am despatched to the town of Rameses Mer-Amen (Pa-Rameses* Mer-Amen) take care that they are got ready." The Chantress of Amen, Sherau-Ra, writes a letter of affectionate greeting to one Piai, evidently her near relative, invoking the Gods to grant him health, strength, and the favour of the King. "All is well with me," she says, "I live. Be not anxious about me; but my heart would fain have news of thee daily. Behold, I go to-morrow to rejoin thee at Pa-Rameses Mer-Amen," &c. Others of these letters name Pa-Rameses still more incidentally, the writers merely invoking "all the Gods of Pa-Rameses" to bestow health, and strength, and long life upon the person to whom the communication is addressed. Some of these scribes and letter-writers lived at Memphis, but others were evidently residents of Pa-Rameses. We must not forget, however, that there were three towns of this name†, and possibly more than three. It is therefore just as likely that the foregoing allusions may have been made with reference to a Pa-Rameses not identical with the Pa-Rameses which was built by the Hebrews. When, however, we turn to the evidence of the Anastasi papyri, we at once tread on surer ground. Here is a curious descriptive fragment, of which we possess two copies, in the above collection:—

"His Majesty has built himself a Bekhen, the name of which is Aa-nekht. Its station is between Zahi (Palestine) and Egypt. It is provisioned with all kinds of delicious food. It is planned like Hermonthis (Erment). It is stable as Memphis. The sun rises and sets upon its double horizon. All men hasten to remove from their own cities, that they may live within its boundaries; having the Abode of Amen[1] in the west, the abode of Sutekh[2] in the south, Astarte[3] in the east, and Ouadji[4] in the North. The Bekhen is as the double horizon of heaven, Rameses Mer-Amen is its God," &c.

The word *Bekhen* is of frequent occurrence in the papyri. Its meaning is somewhat vague, but in its ordinary occupation it would seem to be a military store-house and stronghold; a place where provisions and arms might be kept in readiness, and where booty might be conveniently deposited. In this sense it answers with peculiar fitness to the Hebrew ערי מסכנות translated "treasure-cities." Professor Maspero renders "*Bekhen*" by "villa"; meaning thereby a sumptuous royal residence including temples, barracks, and all kinds of buildings, like the villas of the Roman Emperors. In this sense, a *Bekhen* of the extent and splendour above described may well be translated by "villa." All *Bekhennu*, however, were not fortresses,

* Translated for the first time completely by M. E. Naville, in "Records of the Past," Vol. XII. The same inscription, with a few necessary alterations, was appropriated to his own honour by Rameses III., and is sculptured on one of the pylons of the Temple of Medinet Haboo, built by that Pharaoh.

* Mer-Amen (beloved of Amen) is an integral part of the name of Rameses II. Its addition here in no wise affects the identity of the name of the town. "Pa-Rameses Mer-Amen" would, in fact, be more correct than "Pa-Rameses." It was also sometimes called Pa-Rameses Aanekht, or the town of Rameses the Victorious.

† See Knowledge, No. 44, p. 229.

1. *Amen*, the great God of The Thebaid. 2. *Sutekh*, the God of the Hykshos and Hittites. 3. Astarte, a Sidonian Goddess admitted into the Egyptian Pantheon. 4. Ouadji, the Goddess of the North.

or palaces, or temples; and, as M. Chabas has pointed out, the name *Bekhen* is sometimes applied to the dwellings of private persons.

Although the *Bekhen* of the present papyrus is not actually called Pa-Rameses, we are told that its name was Aa-nekht, and Aa-nekht was the secondary name of Pa-Rameses (see preceding footnote). Also, it was a new *Bekhen*, which his majesty had "built for himself"; and it was stationed between Egypt and Palestine, which was the precise position of the Land of Goshen; and Rameses Mer-Amen was "its God." Here, again, we have all the conditions necessary to the identification of the *Bekhen* Aanekht with the Pa-Rameses of the Aboo Simbel inscription, as well as with the "Raamses" of the Bible.

The following description of Pa-Rameses (evidently the same Pa-Rameses) is from the pen of the scribe Amen-em-apt, who writes to the scribe Panbesa, announcing the arrival of the Pharaoh, Menephthah, then travelling in Lower Egypt:—

"Lo, here is one shall bring to thee this writing of cadenced words. When thou receivest my letter, see that thou takest 50 bronze outen*—or rather 100 outen—from the hand of the scribe Ra-aïï for the use of the servitors in the divine abode (Temple) of Rameses Mer-Amen. . . . . See that thou do it quickly, for behold Ba-en-ra Meramen (Menephthah) to whom be life, health and strength, comes this way towards his birthplace in Heliopolis. . . . . Oh, very bright is the day of Thy coming†! Oh, sweet is Thy voice in speech! It is Thou who has enclosed Pa-Rameses with a wall—the frontier of the land of the foreigner; the boundary of Egypt, Oh, gracious Lord! the beautiful outpost; the tower adorned with lapis and turquoise; the exercise-ground of the cavalry; the parade-ground of the archers; the landing-place of Thy maritime auxiliaries who bring Thee tribute! Praises be to Thee who comest with thy warriors discharging poisoned and burning arrows! The Shasu (Bedaween) flee when they behold the Pharaoh," &c.

In this extract, the points to be especially noted are, firstly, the allusion to the Temple of the deceased Pharaoh, Rameses, deified; secondly, the fact that this Pa-Rameses is a frontier place on the side of the Shasu, or Bedaween Arabs; thirdly, that it was a place of communication by water with the sea, and that the maritime auxiliaries came thither in their galleys; fourthly, that it had been enclosed in a wall of circuit by the reigning Pharaoh, Menephthah Ba-en-Ra Mer Amen, son and successor of Rameses II. This last, as we shall hereafter see, is a point of much importance.

The statistics of longevity in Prussia are striking. In December, 1880, there were living 359 persons who were at least 100 years old, 128 of them being men and 231 women. Of the men, 32 were still married; of the women, five were. Twelve of the men had never married and nine of the women never had. Of persons born between 1781 and 1790, 5,355 were still living, the men being 2,025 in number and the women 3,330. The records further show that the number of persons born in the last century and still living—those, therefore, who were at least eighty years of age—reached a total of 77,668.

* The ancient Egyptians had various metallic substitutes for coin, which were used as conventional signs of exchange. The bronze outen weighed 91 grammes. The subject of later Egyptian moneys of the Ptolemaic period has been learnedly and exhaustively treated by M. Revillout, in his "Chrestomathie Démotique;" so solving many problems that have long baffled both Egyptologists and numismatists.

† The scribe here breaks into an effusion addressed to Menephthah. This change of tense is common in Egyptian texts.

THE RAIN-BAND.*

By C. Piazzi Smyth, Astronomer Royal for Scotland.

WHAT may be done with the spectroscope in the matter of weather is, for the present at least, confined almost entirely to the question of rain—as, Will it rain, or will it not; and, if it will, heavily or lightly? The manner in which the spectroscope accomplishes this useful part is by its capacity for showing whether there is more or less than the usual quantity of watery vapour permeating the otherwise dry gases in the upper parts of the atmosphere, this watery vapour not being by any means the visible clouds themselves, but the invisible water-gas out of which they have to be formed, and by means of which, when overabundant, they obtain their privilege for enacting rainfall. So that never were wiser words uttered and more terse philosophy than those which are to be found in the ancient Book of Job, wherein, of the wondrously "balanced clouds" high up in mid-air, it is said, "They pour down rain according to the vapour thereof."

More or less of this water-vapour is always in the air, even on the very clearest days, and a happy thing for men that it is so; for, as Dr. Tyndall and others have well shown, it moderates the excesses of hot solar radiation by day and cold radiation of the sky at night, and is more abundant in the hotter than the colder parts of the earth. Wherefore, according largely to its temperature for the time being, the air—otherwise consisting almost entirely of nitrogen and oxygen—can sustain, and does assimilate, as it were, a specified amount of this watery vapour, invisibly to the naked eye, the microscope, or the telescope; but not so to the instrument of recent times, the spectroscope. And if the air vertically above any one place becomes presently charged with more than its usual dose of such transparent watery vapour (as it easily may, by various modes and processes of nature), the spectroscope shows that fact immediately, even while the sky is still blue; clouds soon after form, or thicken if already formed, and rain presently begins to descend.

But how does the spectroscope show to the eye what is declared to be invisible in all ordinary optical instruments? It is partly by its power of discriminating the differently-coloured rays of which white light is made up, and partly by the quality impressed on the molecules of water at their primæval creation, but only recently discovered, of stopping out certain of those rays so discriminated and placed in a rainbow-coloured order by the prism and slit of the spectroscope, but transmitting others freely. Hence it is that, on looking at the light of the sky through any properly-adjusted spectroscope, we see, besides the Newtonian series of colours from red to violet, and besides all the thin, dark Fraunhofer, or solar originated lines, of which it is not my object now to speak, we see, I say, in one very definite part—viz., between the orange and yellow of that row of colours, or "spectrum," as it is called—a dark, hazy band stretching across it. That is the chief band of watery vapour; and to see it very dark, even black, do not look at a dark part of the sky or at black clouds therein, but look, rather, where the sky is brightest, fullest of light to the naked eye, and where you can see through the greatest length of such well-illumined air, at a low, rather than high, angle of altitude, and either in warm weather, or above all, just before a heavy rainfall, when there is and must be an extra supply of watery vapour in the atmosphere. Any extreme darkness, therefore, seen in that water-

* From the *Times*.

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vapour band beyond what is usual for the season of the year and the latitude of the place is an indication of rain-material accumulating abnormally; while, on the other hand, any notable deficiency in the darkness of it, other circumstances being the same, gives probability of dry weather, or absence of rain for very want of material to make it; and the band has, therefore, been called, shortly, "the rain-band." Thus, also, "rain-band spectroscopes" have been specially constructed by several most expert opticians in size so small as to be carriable in the waistcoat pocket, but so powerful and true that a glance of two seconds' duration through one of them suffices to tell an experienced observer the general condition of the whole atmosphere. Especially, too, of the upper parts of it, where any changes —as they take place there almost invariably earlier than below—enable such an observer to favour his friends around him with a prevision of what they are likely soon to experience.

As an example of what may be done, and done easily, after a certain amount of experience and understanding of the subject has been acquired, I append, from a lady's meteorological journal, her notes of the mean temperature of the air and the intensity of the rain-band for each of the first fifteen days of the present month; and in a final column have entered the amount of rainfall measured at the Royal Observatory, Edinburgh, on each of those days. The darker the rain-band the larger is the figure set down for it; and it will be seen pretty plainly, on running the eye down that column and the next one, that with an intensity of either 0 or 1 no rain follows, or, we might almost say, can follow; but with an intensity of 2 rainfall begins, and with 3 it may be very heavy. All these rain-band notes have been made with a spectroscope no larger than one's little finger, purchased some six years ago, and taken on many voyages and travels since then :—

Date, September, 1882.	Mean Temperature of the air. Deg. Fahr.	Rain-band intensity.	Depth of Rain measured in gauge at Royal Observatory, Edinburgh. Inch.
Friday, 1	57·1	3	·044
Saturday, 2	59·2	2	·353
Sunday, 3	58·6	2	·015
Monday, 4	54·4	0	0
Tuesday, 5	55·7	1	0
Wednesday, 6	55·2	0	0
Thursday, 7	53·8	1	0
Friday, 8	59·4	0	0
Saturday, 9	54·0	1	0
Sunday, 10	57·0	1	0
Monday, 11	52·2	1	·040
Tuesday, 12	48·6	0	0
Wednesday, 13	52·8	1	0
Thursday, 14	49·5	3	·62
Friday, 15	56·2	2	·570

(To be continued.)

HIGH TIDES.

MR. JAS. PEARSON, M.A. (author of an excellent treatise on the Tides), writes as follows to the *Times* :—The spring tides of March and September always rise considerably higher than those in any other months of the year, but it is only when a combination of astronomical and atmospheric circumstances favours their development that their effects become remarkable. The magnitude of the lunar and solar attractions on the ocean is a matter of accurate prediction; the disturbing influence of the atmospheric pressure, both as regards direction and magnitude, is fickle and uncertain from year to year. It so happens that at the end of the present month—*i.e.*, on Tuesday, Wednesday, Thursday, and Friday in next week —each of the constituent forces by which the tides are generated is at its *maximum*, or very nearly so; it depends entirely on the weather how far their effects may be augmented. But there is this to be noticed, that the night tides considerably exceed the day tides by reason of what is technically called the "diurnal inequality." The explanation of this inequality has up to the present time been a difficulty, and even now the latest interpretation of it has not been generally published. Old-fashioned observers used to say that its periodicity coincided with that of "the dews," and they supposed the two classes of phenomena were in some way connected. Nothing, of course, could be more foolish than such an idea. The "diurnal inequality" of the tides can be most satisfactorily accounted for. Although to an ordinary observer the day and night tides seem to approach our shores under precisely similar conditions, yet, in reality, neither in their course of travel nor in their mode of production do they exactly resemble each other.

The largest tide has its magnitude augmented by the fact that the crest of the tide-wave which follows the moon travels daily from the Southern to the Northern Hemisphere in a direction most nearly coincident with that of the great expanse of water in the Atlantic Ocean over which it passes; the smaller tide has its magnitude diminished not only because it is due to the action of the moon on that side of the earth most remote from it, but more than all because its course is partly diagonal to that of the former, the tide-wave crossing the Atlantic, roughly speaking, in the direction of its breadth, while in the other case it crosses in the direction of its length.

Computation gives the following as the heights of the tides at Liverpool on the before-mentioned days :—Tuesday : day tide, 27 ft. 3 in. ; night tide, 29 ft. 1 in. ; Wednesday : day tide, 28 ft. 6 in. ; night tide, 30 ft. 2 in. Thursday : day tide, 29 ft. 2 in. ; night tide, 30 ft. 4 in. Friday : day tide, 29 ft. ; night tide, 29 ft. 5 in. ; 8 ft. 6 in. to be subtracted for height above Old Dock-sill at George's Pier.—Yours, &c., JAMES PEARSON, M.A., F.R.A.S.

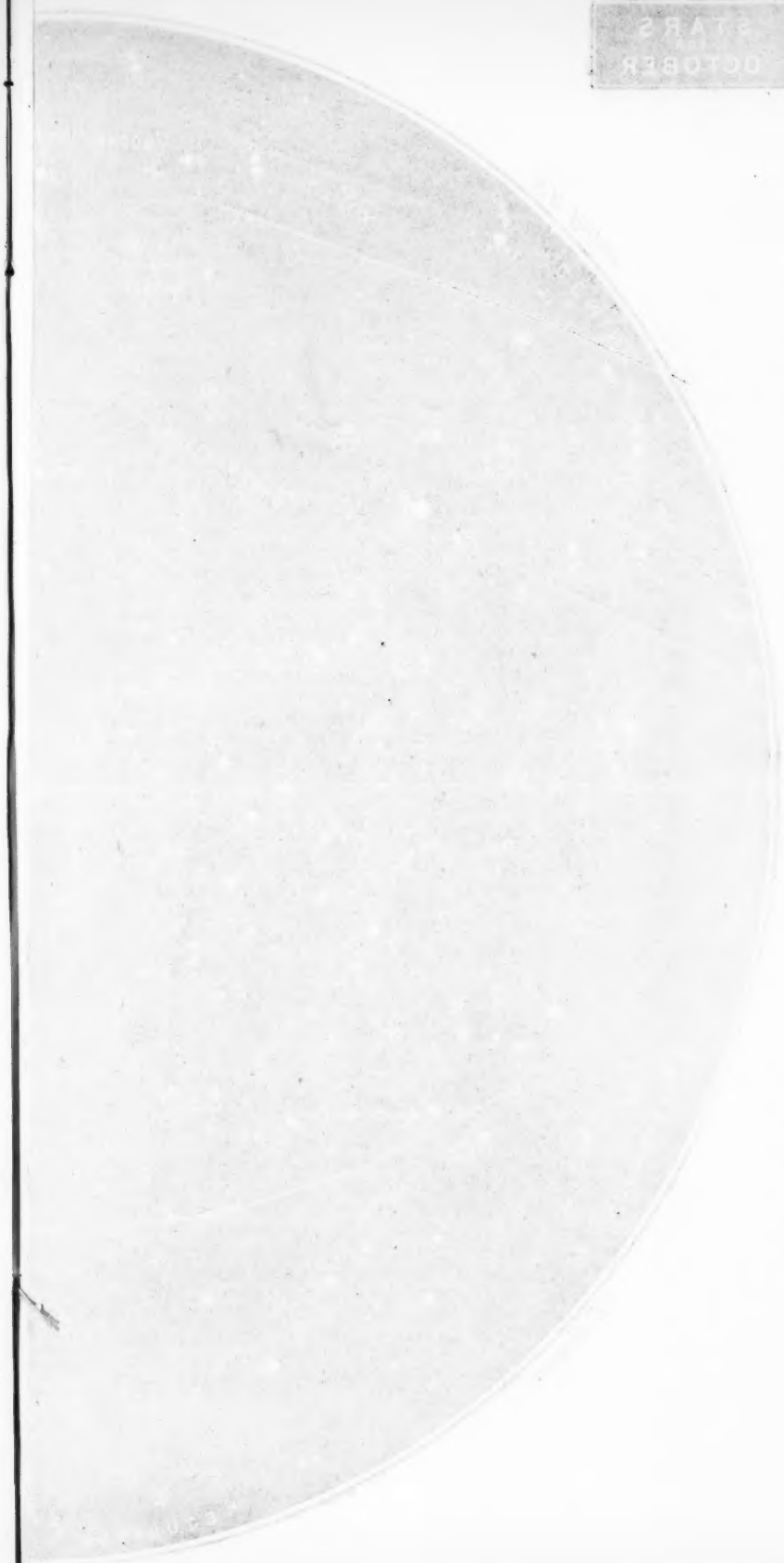
Fleetwood Vicarage.

WHO DISCOVERED THE DIVISION IN SATURN'S RING?

THE real historical importance of the subject of this letter must be accepted as my excuse for an intrusion into your already terribly overcrowded columns.

On p. 217 of Breen's "Planetary Worlds," the author says : "Shortly after this discovery a division in the ring was detected by the English observer Ball ; and Huyghens was written to in 1665 by Wallis to direct his attention to the anses (*sic*) or ring, and to see "whether he there meets with nothing that may make him think that it is not one body of a circular figure that embraces his disc, but two?"* Can any one of my brother readers of KNOWLEDGE tell me where this letter of Wallis's is to be found? My reason for inquiring is this, that during a recent very interesting discussion with my friend Mr. C. Leeson

[* It seems to me, by the way, quite possible that Wallis here referred to two bodies on opposite sides of the ball, not to two concentric rings. Ball's picture shows nothing of the latter sort; yet seems somehow to have been regarded *at the time* as agreeing with Wallis's idea; whence possibly, *later*, when that idea was misunderstood, the mistake as to Ball's observation. The inquiry is interesting.—ED.]



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STARS FOR OCTOBER

Our Star Map.—The circular boundary of the map represents the horizon. The map shows also the position of the equator and of that portion of the Zodiac now most favourably situated for observation. The names of ninety-nine stars of the first three magnitudes are given below.

On Sept. 29, at 10·30 p.m.
On Oct. 2, at 10·15 p.m.
On Oct. 6, at 10· 0 p.m.
On Oct. 10, at 9·45 p.m.
On Oct. 14, at 9·30 p.m.
On Oct. 18, at 9·15 p.m.
On Oct. 21, at 9· 0 p.m.
On Oct. 25, at 8·45 p.m.
On Oct. 29, at 8·30 p.m.

ARABIC NAMES OF STARS.

The following table exhibits the names of all the stars of the first three magnitudes whose names are in common use:—

α Andromedæ ...	... *Alpheratz*
β ——— ...	... *Mirach, Mizar*
γ ——— ...	... *Almach*
α Aquarii ...	... *Sadalmelik*
β ——— ...	... *Sadalsund*
δ ——— ...	... *Skat*
α Aquilæ ...	... *Altair*
β ——— ...	... *Alshain*
γ ——— ...	... *Tarazed*
α Arietis ...	... *Hamal*
β ——— ...	... *Sheratan*
γ ——— ...	... *Mesartim*
α Aurigæ ...	... *Capella*
β ——— ...	... *Menkalinan*
α Boötis ...	... *Arcturus*
β ——— ...	... *Nekkar*
ε ——— ...	... *Izar, Mizar, Mirach*
η ——— ...	... *Muphrid*
α Canum Venat. ...	... *Cor Caroli*
α Canis Majoris ...	... *Sirius*
β ——— ...	... *Mirzam*
ε ——— ...	... *Adara*
α Canis Minoris ...	... *Procyon*
β ——— ...	... *Gomeisa*
α^2 Capricorni ...	... *Secunda Giedi*
δ ——— ...	... *Deneb Algiedi*

α	Cassiopeiæ ...	... *Schedar*
β	———	... *Chaph*
α	Cephei ...	... *Alderamin*
β	——— ...	... *Alphirk*
γ	——— ...	... *Errai*
α	Ceti ...	... *Menkar*
β	——— ...	... *Diphda*
ζ	——— ...	... *Baten Kaitos*
ο	——— ...	... *Mira*
α	Columbæ ...	... *Phact*
α	Coronæ Borealis	... *Alphecca*
α	Corvi ...	... *Alchiba*
δ	——— ...	... *Algores*
α	Crateris ...	... *Alkes*
α	Cygni ...	... *Arided, Deneb Adige*
β	——— ...	... *Albireo*
α	Draconis ...	... *Thuban*
β	——— ...	... *Alwaid*
γ	——— ...	... *Etanin*
β	Eridani ...	... *Cursa*
γ	——— ...	... *Zaurac*
α	Geminorum ...	... *Castor*
β	——— ...	... *Pollux*
ζ	——— ...	... *Alhena*
δ	——— ...	... *Wasat*
ε	——— ...	... *Mebsuta*
α	Herculis ...	... *Ras Algethi*
β	——— ...	... *Korneforos*
α	Hydræ ...	... *Alphard, Cor Hydræ*
α	Leonis ...	... *Regulus, Cor Leonis*
β	——— ...	... *Deneb Aleet, Denebola, Deneb*
γ	——— ...	... *Algeiba*
δ	——— ...	... *Zosma*
α	Leporis ...	... *Arneb*
α	Libræ ...	... *Zuben el Genubi*
β	——— ...	... *Zuben el Chamali*
γ	——— ...	... *Zuben Hakrabi*
α	Lyræ ...	... *Vega*
β	——— ...	... *Sheliak*
γ	——— ...	... *Sulaphat*
α	Ophiuchi ...	... *Ras Alhague*
β	——— ...	... *Cebalrai*
α	Orionis ...	... *Betelgeux*
β	——— ...	... *Rigel*
γ	——— ...	... *Bellatrix*
δ	——— ...	.. *Mintaka*
ε	——— ...	... *Alnilam*
α	Pegasi ...	... *Markab*
β	——— ...	... *Scheat*
γ	——— ...	... *Algenib*
ε	——— ...	... *Enif*
ζ	——— ...	... *Homan*
α	Persei ...	... *Mirfak*
β	——— ...	... *Algol*
α	Piscis Australis	... *Fomalhaut*
ε	Sagittarii ...	... *Kaus Australis*
α	Scorpionis ...	... *Antares, Cor Scorpionis*
α	Serpentis ...	... *Unukalhai*
α	Tauri ...	... *Aldebaran*
β	——— ...	... *Nath*
η	——— ...	... *Alcyone* (Pleiad)
α	Ursæ Majoris	... *Dubhe*
β	——— ..	... *Merak*
γ	——— ...	... *Phecda*
ε	——— ...	... *Alioth*
ζ	——— ...	... *Mizar*
η	——— ...	... *Alkaid, Benetnasch*
ι	——— ...	... *Talitha*
α	Ursæ Minoris	... *Polaris*
β	——— ...	... *Kochab*
α	Virginis ...	... *Spica Azimech, Spica*
β	——— ...	... *Zavijava*
ε	——— ...	... *Vindemiatrix*

XUM

Prince, F.R.A.S., on the subject of Saturn's ring, I have been induced to examine into the evidence which exists as to the personality of the observer who first saw it divided into two concentric ones. On p. 49 of the first edition of your own "Saturn," Sir, I find you saying that "in 1665 William Ball discovered a black stripe of considerable breadth, running quite round the northern surface of the ring, and having its outer and inner edges concentric with the ring." Going back, I find Mr. Hind, in his "Solar System" (published in 1852), p. 105, attributing this discovery to William Ball and his brother Dr. Ball; and prior to this again the late Admiral Smyth stating the same thing as to the two brothers seeing it, in vol. i. p. 51, of his "Celestial Cycle" (the "Prolegomena"). Now, I fancy that I have succeeded in tracing the (at all events, modern) authority for this, in that wonderful farrago, Kitchiner on Telescopes. On p. 354 of that work the "Cook's Oracle" thus delivers himself: "The earliest account which I have met with of an observation of the Division in Saturn's Ring is in the *Phil. Trans.* for 1666, by Mr. Wm. and Dr. Ball, on October the 13th, 1665, at 6 o'clock, with a very good telescope, near 38 feet long, and a double eye-glass. This observation has induced the supposition that Saturn is surrounded not by *one* circular body or ring only, but by *two*." I would ask the reader to note carefully the verbal correspondence between this concluding sentence and that alleged by Breen to have been used by Wallis in his letter to Huyghens of the same year. Well, naturally, the first thing Mr. Prince and I did was to refer to the *Philosophical Transactions* for 1666, and, on doing so, I found to my great astonishment that everything that appeared there on the subject was a communication from Mr. William Ball, of Mainhead, which I here reproduce *verbatim et literatim*. "LXXVII Oct. 13, 1665, at six of the clock, with a very good telescope near 38 foot long and a double eye-glass, *Saturn* appeared to me somewhat otherwise than I expected, thinking it would have been decreasing, but I found it as full as ever, and a little hollow above and below (Plate 3, Vol. I., Fig. 132)."

I append a facsimile of the engraving which illustrates this bald and meagre statement. Not one word about the "Dr." Ball who appears in the later narratives, nor of the "two bodies of circular figure that embrace the planet's disc." Nay, in the illustrative drawing not a vestige of an indication of division in the ring! It is, of course, possible that Wallis (who, as is well known, was the Savilian Professor of Geometry at Oxford, and was one of the founders of the Royal Society) may have been in communication with the brothers Ball on the subject of their observation, and may so have learned orally what induced him to write and question Huyghens; but certainly nothing in William Ball's printed observation could have justified Wallis's question. This is why I am curious to learn whether Wallis's letter to Huygens is still extant, and, if so, where it is to be found. At present the evidence connecting Ball with the original discovery of the division in Saturn's ring seems to me to be of the most slender kind possible.

Forest Lodge, Maresfield, Uckfield. WILLIAM NOBLE.

ANIMALS IN NORWAY.

A CORRESPONDENT of the *Times* (A.G.B.K.), makes the following remarks on a very pleasant feature of the Norwegian character, viz., kindness to domestic animals. "In that country," he says, "these animals are treated as the friends rather than the slaves of man. As a result, vicious horses are unknown; foals follow their dams at work in the fields or on the road as soon as they have sufficient strength, and thus gently accustom themselves to harness. I heard of a foal trying to force its head into a collar in imitation of its mother. Horses are trained to obey the voice rather than the hand, bearing-reins are not used, and the whip, if carried at all, is hardly ever made use of. Great care is taken not to overload carts, especially in the case of young horses, and consequently a broken knee is rarely seen, and the animals continue fat, in good condition, and capable of work till the advanced age of 25 or 30. So tame are the Norwegian horses and cows that they will allow casual passers-by to caress them while they are lying down. Even domestic cats will approach a boy with confidence, knowing that no chasing or worrying awaits them. One very hot summer's day I met a woman holding up an umbrella to carefully screen what I supposed was a little child at her side from the scorching rays of a mid-day sun, while her own head was covered only by a handkerchief. In driving by I tried to gain a glimpse of her charge, and found, to my great surprise, that the object of her care was a fat, black pig. The question of humane methods of slaughtering animals has lately been prominently brought forward in England. In this the Norwegians show us a good example; they never use the knife without first stunning the animal. In the above remarks I am alluding to the country districts of Norway; in the towns the national characteristics become modified, although even under these conditions kindness to animals is still remarkable.

To those whose hearts are sickened by the sights of cruelty daily witnessed in our streets it must be a consolation to learn that a country exists where these things are unknown, where men are instinctively considerate to the animals dependent on them, and where no legislation is required to enforce the claims of the dumb creation.

THE ENDOWMENT OF RESEARCH.

A DISCUSSION took place on this subject on the second day of the Social Science Congress in the Department for Education. The general feeling seemed to be against those special forms of endowment which have been advocated by certain *now* tolerably active workers. The discussion is thus reported in the *Times*:—

Mr. Rowland Hamilton, hon. secretary of the Department, introducing the question from the general educational standpoint which it had always been the object of the department to maintain, inquired (1) into the relation which the prosecution of research bears to our national system; (2) how it may affect and be affected by the efforts now made to extend general culture; and (3) into its claims on our national resources. In the early stages of training the methods which conduce most to insure sound teaching are the same as those which will best qualify pupils in after life to take their part in such work as that of original investigation, and the endowment of research should not trench upon the means devoted to thorough liberal education in any of its branches. The

advantages which the influences of scientific method should afford to our educational system will be amply repaid by the increased number and efficiency of those who will hereafter be able to take part in scientific work and an intelligent and practical interest in its progress. The educational uses of scientific teaching have yet to be fully considered, and we might reap them by the endowment of one or more professorships, round which the experiences of many who are interested in this important branch of the subject might concentrate, alike to the advantage of "liberal" culture and of more special training for the labours of research. As to the endowment of the more special forms of research as more commonly understood, there is hardly any limit which it is desirable to assign to it, provided due assurance is given that the work desired is efficiently carried out. The services thus rendered are pre-eminently of general and national importance, and must be provided for by national expenditure. The economic doctrine of supply and demand as regards the interchange of individual services is wholly inapplicable to the question. The difficulty lies in the administration of the funds devoted to such purposes, so as to insure that they are given to those duly qualified to use them. The method of State grants in aid, dispensed through the agency of existing societies and learned bodies who have earned a title to public confidence, might be largely developed with the greatest advantage, and the relative functions of the Government and of such societies in their relation to this subject were discussed. The multiplication of "idle fellowships" had a demoralising tendency. While any undue interference on the part of the central administration was to be altogether deprecated, it was essential to reserve to the State an ultimate and *quasi* judicial control, which would best secure that publicity and definite responsibility which are the best safeguards against abuses in any direction.

Mr. Cooke Taylor, who opened the discussion, said this was an age of investigations. He was not much in favour of the endowment of research, but if they were to have it, it should be upon the lines laid down by Lord Bacon in his "New Atlantis."

The Rev. J. F. M'Callan, one of the local secretaries, believed that discovery was promoted not by endowment, but by enthusiasm. In his opinion, the endowment of research would be merely making a perch for active men to go to sleep upon, and would not promote investigation in any special way.

The Rev. J. Bevan thought a good deal might be done by private enterprise.

Mr. Walter Wren (London) said that rewards ought to be given for something done, and not payment for something to be done. He regarded this agitation for the endowment of research as a new form of alms-begging or charity-hunting. By endowments they would be simply opening the door to jobbery on a most gigantic scale.

After some further discussion,

Mr. Hamilton replied. He said he entirely agreed with Mr. M'Callan and Mr. Wren with regard to what was called the abuse of the endowment of research. By the endowment he simply meant that those who were engaged in research should, upon due proof that they were so engaged, be exempt from carking cares and difficulties. People could not live upon nothing, and there was no doubt that at present any object of research must be investigated by people of independent means. He thought it would be well that means should be provided so that those engaged in research might obtain assistance without feeling under a personal obligation to anyone.

Reviews.

A SCHOOL BOOK ON HEAT.*

IT is singular how few of those who are not actually students of physics have any clear idea of the nature of heat, the laws of its reception, transmission, and radiation. The most absurd mistakes are made on these subjects when any simple phenomenon of heat is familiarly discussed. As the phenomena of heat are the most common of all those which ordinary life brings into our notice, they might well be studied in our schools, instead of some of those preposterous subjects which the folly of the fifteenth century set as the chief matters for school-training, and the stupidity of the nineteenth persists in retaining. If the wiser of the earlier period had selected subjects for study, or if the more sensible of our own day had their way, our children would not be obliged to learn a number of matters of no earthly use to most of them while subjects which actually include the very laws of their existence are utterly neglected. A bright boy of fourteen shall repeat for you glibly, in Latin, the rules of Greek syntax or prosody, and translate a page of some more or less offensive poetry about the loves of gods and goddesses; and when he is forty he will positively remember enough of his classical lore to know the origin of most of those English words which have been derived from Latin or Greek (which knowledge might all have been obtained in the compass of a week at the outside). But ask him how exercise makes him warm? why flannel is good for his cricket suit on a hot summer's day, and also for his football suit in winter? why his breath forms a visible cloud on a cold day and not on a hot one? or any simple question of this sort, and the chances are (even now, when physical science is supposed to be taught in our schools) that he will be all at sea.

Among the adult, ignorance about the laws of heat is still more common and still more surprising. For a boy cannot be expected to learn what no one cares to teach him; and if he finds that he cannot gain credit and prizes without being able to write Latin verses or to show that triangles are to each other in the duplicate ratio of their homologous sides, he will give all his studying time to these things, just as he would give it to the study of chess or whist if proficiency in these pursuits were made (as it might as wisely be) the test of progress. But that persons who have leisure for study should remain absolutely ignorant of such subjects as the laws of heat, light, and so forth, laws relating to phenomena constantly occurring, is less easily explained, unless it be regarded as the result of a carefully instilled feeling of disregard for all that takes place around them.

Yet our own experience shows us that many who obviously know little would like to know a great deal about such matters. We receive multitudes of letters showing that though the writers may not know the difference between conduction and convection, or may regard specific heat as some special kind of heat (like obscure heat, for instance), while the mechanical theory of heat is obscurer to them than a half-obliterated manuscript in Goojurattee Indian, they are very anxious to learn what science has to say on these subjects.

To all such we very strongly recommend Mr. Larden's excellent book on Heat. It is intended as a text-book for use in our public schools; but (while admirably suited for that purpose) it should be read by all who wish to have

* *A School Course on Heat.* By W. Larden, M.A., Assistant-Master in Cheltenham College. (Sampson Low, Marston, & Co., London.)

clear ideas about the physics of heat as at present understood. Mr. Lardner assumes that the reader of the book has no previous knowledge of physical science at all. His explanations, therefore, are at first very elementary in character. Farther on, as the reader gradually becomes familiar with his subject, they become more succinct. The mathematical parts require no very profound study of mathematics, and are very clearly, yet satisfactorily, dealt with. (The general reader, even if he has enough mathematical knowledge to master these portions easily, can pass lightly over them, content to recognise the principles on which calculation is based, without wasting his time in testing their accuracy.) The questions and examples given at the end of each chapter are excellent. We have been particularly struck by the completeness of the treatment of the various subjects: just, too, where difficulties are likely to occur, they are referred to, and removed. The illustrations throughout are excellent.

There are a few slight errors here and there. For instance, at p. 8, "the end C" of a tube is mentioned, though it has no existence in the figure; on page 204, we find specific heats C_1 and C_2, instead of c_1 and c_2; and so forth. But the work contains so much, that the wonder rather is that there are not more mistakes of this kind. Among errors of a different sort may be mentioned the statement that astronomers believe the sun's heat to be maintained by the downfall of bodies which had been travelling around the sun, and the remark that the planets are known to be slowly but surely closing in towards the sun. (There is a footnote on the same page—288—referring to Dr. Siemens's theory, which has been unanimously rejected, or neglected as not needing rejection, by all who are competent to form an opinion upon it.) Our author's remarks on the tides also, are open to misconception, where he speaks of the earth "in its daily revolution sweeping through the protuberance of water due to the moon's attraction."

But these faults are slight and easily corrected in later editions of the work. They detract scarce perceptibly from the great value of this thoroughly excellent and honest book, every page of which shows signs of careful study to make matters clear and simple to the reader. The contrast between this book and some of the trashy text-books of science which are finding their way into use is most marked. The latter part of the work is naturally the most interesting, as there is less occasion for explanation of general principles. The chapters on Radiation, the Mechanical Theory of Heat, and Heat Engines, ought to be as interesting as a well-written story to an intelligent learner.

BIBLE ENGLISH.*

MR. WASHINGTON MOON is the self-appointed guardian of the English language. Ever since he sat in judgment on "The Queen's English" in "The Dean's English," and was commended by those rather questionable judges, "the young buccaneers of the press," he has missed no opportunity to exhibit his logical precision, his acumen in detecting faults, and his familiarity with Lindley Murray. He not only points out errors in the writings of all our best authors, but when those among the living ones who think it worth while, defend themselves, he shows them how their defence ought to have been worded. In the work before us he "presumes," he says, "to take upon himself" the "consideration of the revised New Testament regarded grammatically."

We do not know Mr. Moon personally; but we should imagine he must be a troublesome person to converse with. If not, his works belie him. We picture him speaking—in the ordinary converse of life—somewhat as in the following imaginary scene:—

TRAVELLER (meeting Mr. Moon).—Can you tell me, sir, where this road goes?

MR. MOON (*aside*).—He should have said, "If you can, *will* you tell me?" (*Aloud.*) Sir, the road does not go anywhere, it remains always here.

TRAVELLER.—Pardon me. I should have said, "Where does this road lead?"

MR. MOON.—To lead, sir, is to go before—to guide (*vide* Webster, Worcester, and Walker, especially Walker). The road cannot go before you.

TRAVELLER.—I perceive, sir, you are precise. I want to know where I shall arrive if I follow this road?

MR. MOON.—You cannot follow that which is at rest, for the word *follow*——

TRAVELLER.—Excuse me, my time is limited. Where shall I arrive if I travel on this road?

MR. MOON.—Your query is wanting in precision. Where you arrive will depend principally on the duration of your progression.

TRAVELLER (*after a pause*). Supposing I should walk upon this road, at a rate of, say, four miles per hour, during, let us suppose, two hours, what are the various places through or near which my walk will bring me?

MR. MOON. This is very painful. There are no less than seven mistakes of the most glaring kind in the sentence you have just spoken. Your use of the word "supposing" is quite inaccurate. Who are supposing? Then, having already used the word once, you should not have used it again in the same sentence. Again, what does "say" mean? Also, why use the Latin word *per*, when "in an" would have served your purpose? You speak of *various* places. But the word various, so used, is quite unmeaning. If it were not redundant it would be incorrect, for the word various implies that the objects to which it is applied vary from each other. Now, the places through which you have to pass may, for aught you know, be precisely alike. Further, you should not have said "my walk," but "my walking." The word "bring," also, is inappropriate. I will go home and write an essay on each of the questions which I have raised respecting your incorrect language; and——

TRAVELLER. In the meantime, will you kindly tell me what I want to know?

MR. MOON (*aside.*) He does not mean "in the meantime," but *before that.* (*Aloud.*) No, sir; that is what *you* should tell *me.* Not to speak of telling you, how can I even *learn* what you want to know, when you fail to express yourself in terms at once clear and accurate. Permit me to quote for your edification a passage from the preface to my treatise on the "Revisers' English." "The mind which allows itself complacently to delight"—

TRAVELLER. How about tautology? [*He goes upon his way.*

MR. MOON. (*Aside.* A most inexact expression!) Understand, sir, that in what I write no one has ever yet detected imperfections—"complacently to delight," I say (*raising his voice*) "in anything below the highest standard of excellence, is thereby dwarfing its faculties; for (*louder*) we become assimilated to that which we worship, and (*shouting*) [we] are ennobled or debased by the influence of that upon which our minds dwell with satisfaction." He is beyond hearing; I will write a series of letters for *Public Opinion*, and point out his multitudinous errors. I *will* be heard; he shall (Saxon, *scealan*) listen to me.

In this spirit Mr. Moon has revised the revisers' English. We do not much admire the revised version of the New Testament. Its authors set themselves an impossible task. They proposed to correct the faults of translation in the Authorised Version, to retain as much as possible of its antique style, to adhere to English idioms, and to write what all should understand. The result is a singular conglomeration of tautology, Greek idiom, obsolete expressions, and commonplace language.

In all former attempts to translate the Bible, the language of the time was adopted, and thus each translation not only expressed the ideas of the Bible writers in such language as men commonly employed, but left to future ages a record of the language in each successive stage of its development. Our revisers have been afraid

* "The Revisers' English," by G. WASHINGTON MOON, F.R.S.L., author of "The Dean's English." (London: Hatchard's.)

XUM

to attempt this. As priests wear garments which were fashionable several generations ago, and as in former times flint implements were used in sacred offices to do what for ordinary purposes was done with instruments of steel or iron, so now archaic forms of expression seem to be regarded as essential in religious books. One wonders whether faith has become so weak that the Bible would not bear translation into the language used by the prose writers of the present day.

The difficulties which the revisers thus created for themselves have naturally led to faults of execution, and on such faults Mr. Moon has pounced with characteristic delight. Where the revisers have very carefully followed the text, they scarcely write English, though they have adopted as a principle that the idiom of our language should not be violated by forms of expression which it cannot bear. But Mr. Moon, in his anxiety to do battle, charges recklessly on perfectly defensible positions. For instance, he adopts as a principle that a verb must be plural when it relates to several substantives; and he will not hear of any objections to this principle, based on the practice of our best writers and speakers. But, as a matter of fact, the question whether the principle is sound or not depends entirely on the practice of writers and speakers. The Greek language is logical, so is ours, so is the French; but in the Greek Mr. Moon's principle has no existence, whereas in French it rules absolutely. Whether it exists in English or not, depends on the practice of our best writers in use,

Quem penes arbitrium est, et jus et norma loquendi.

(A line, which, by-the-way, illustrates the Latin practice). Now, the English custom in this matter is more nearly akin to the Greek than to the French. We can say either "Thine is the kingdom, and the power, and the glory," or "Thine are the kingdom, the power, and the glory." We cannot say "Thine are the kingdom, and the power, and the glory," for the simple reason that the first "and" indicates the reiteration, in reference to the power, and then to the glory, of that which has already been said about "the kingdom." Mr. Moon, in dealing with this particular example, seems quite unable to see how much stronger is the form actually used for the doxology than that which he would substitute. All good writers know that by the use of the singular in such cases, the word "and" acquires the force of "and also." Mr. Moon would probably answer that in that case, "and also" might with advantage be used instead of "and;" for he appears to have not the slightest conception of the weakness, dulness, and heaviness resulting from the constant use of every word which may be essential to the logical completeness of a sentence. His own writing is ponderous to a degree. He crowds incongruous ideas together in long and involved sentences, the meaning of which can seldom be seen at a first reading. Like all criticasters, he aims at fine writing; but in his attempt to combine glowing description with logical accuracy, he often succeeds only in affording "awful examples," and he is not always even quite so accurate as he might be. Here, for instance, is a sentence of his writing :—

> There is scope in the varied themes of the Word of God for the grandest organ-utterances of language; and these, bearing those themes, should peal through the mighty cathedral of the world, in tones which could not but thrill with responsive vibrations the throbbing hearts of its many million worshippers.

This is very fine writing. The "organ-utterances of language" are good; and when you clearly see how these and those are related, you dimly recognise that "these, bearing those, can peal," &c., but whether the many million worshippers (it should be many millions of worshippers), worship the cathedral or the world, or what they worship, is by no means clear. Can Mr. Moon possibly have been afraid to speak of "the many millions who worship in it," because there is a rule which very much troubles weak writers (and a very silly rule it is) that a sentence should not end with small words, prepositions, or pronouns?

It would be well if one who can write English well—accurately yet without affectation—would try the effect of one of the gospels, or even a chapter of one, in the English of our day.

METACHROMATISM, OR COLOUR CHANGE.

By William Ackroyd.

It is usual for people to regard colour as a fixed quality—a quality which it would be as difficult for a substance to alter as for the Ethiopian to change his skin, or the leopard his spots. This idea of the fixity of colour is, however, easily got rid of. Let the reader by an effort of imagination condense a year into a few moments of time, and let him follow with the mind's eye all the changes in fruit, flower, and foliage. Then will it appear to him that the colour of the landscape is ever changing.

On a very small scale the same changeableness of colour may be shown in the laboratory without any appeal to the imagination. Coloured substances may be made to change from tint to tint while one is looking on.

Take a small fragment of bichrome (potassic dichromate) and put it on a piece of white porcelain; heat it strongly over a spirit lamp, Bunsen burner, or any other clean source of heat, it will then be seen that the bichrome changes its colour from red to dark red. Upon cooling, it regains its original colour. Note well that the cold bichrome was red, and the hot, dark red; in other words, the expanded bichrome was dark red, and the contracted red simply. These facts we may tabulate thus :—

Bichrome

When heated or expanded.	↓	Red Dark red	↑	When cooled or contracted.

The arrows refer to the order of colour change—*e.g.*, when one heats the bichrome it changes in the direction of the left-hand arrow, and when one allows it to cool it changes in the opposite order, as shown by the right-hand arrow.

Now, there are many substances which change their colour when they are heated. Thus, oxide of zinc changes from white to yellow and orange, and porcelain even will change from white to yellow. Chromate of barium changes from yellow to orange; chromate of lead from orange to brick-red and black red; mercuric oxide from orange yellow to orange, red, and brown; and suboxide of copper glass from scarlet to blackish red and black. Colour changing bodies regain their usual colour, as a rule, when they have cooled to their usual temperature, although sometimes the exact shade is not regained, probably from the substance not having fully contracted. We have here cases of inorganic adaptation to environment as striking in their way as those of animals acquiring white coats under the influence of Arctic cold, or of white folks becoming dark skinned under the influence of equatorial heat.

In running over the few examples we have given, it will be perceived that in these colour changes, when a body is being heated, there is a certain order which is invariably followed; thus white substances become yellow, but never red or black, and a red substance may become brown or black, but never white. It will be further noted that in one kind of coloured substances black is the extreme result of heating, and, on the other hand, no amount of cooling will carry a substance beyond whiteness; *i.e.*, a hot orange-coloured body may become yellow when cooled, or even white, but nothing else beyond. If we, therefore, arrange a series of colours with white at one end and black at the other, the intermediate members of the scale being placed in the order in which colour changes are observed to take place in various substances, then we obtain a metachromatic scale. The following is *my* metachromatic scale :—

Heating or expanding.	↑	Black Brown Red Orange Yellow Green Blue White or colourless.	↓	Cooling or contracting.

It appears that another metachromatic scale has been devised besides my own. The two scales are not identical, however, nor does the same meaning appear to be attached to both. Thus the deviser of the scale to which I refer, writes:—"White (as being the combination of all colours) concludes the scale at the limit of expansion, and black (as an absence of light) at that of contraction."* This is the very opposite of anything I have ever taught regarding metachromatism, and from the experimental evidence I have already given, the reader will perceive that it is undoubtedly a mistake.

By spectroscopic examination, I have ascertained that the change of colour in a body upon elevation of its temperature is due to increased absorption of light towards the violet end of the spectrum. A simple experiment suggests itself to me by which the reader may demonstrate this point to his own satisfaction without the spectroscope. A borate of copper bead, as obtained in blow-pipe analysis, is blue when cold and green when hot. Now a transparent yellow substance generally absorbs the violet end of the spectrum as far as the blue border of the green, according to the thickness of the absorbing substance. Treacle is a body of this kind. Take the blue bead and dip it in treacle. Upon taking it out with a thin film of treacle covering it, *it appears green*. In other words, covering the bead with a thin film of a substance absorbing the light of the violet end of the spectrum has the same effect, so far as its appearance goes, as raising the temperature of the bead, and consequently the latter operation increases the bead's absorption of the violet end of the spectrum.

As we have seen, this increase in the absorption of light to which metachromatism is due, culminates in blackness, or what would be termed spectroscopically continuous absorption. At the other end of the scale, one would have a continuous spectrum from the absence of absorption, and between the two extremes, partial absorption. In 1874 Lockyer proposed† five orders of spectra, ranging from the spectroscopic appearances of bodies at ordinary temperatures to the emission spectra of high temperatures. I regard his 3rd, 4th, and 5th orders as misplaced, and would substitute for them the orders I have placed opposite them in the following comparison. The error has evidently arisen from a mixed study of what I have termed transverse and structural absorption effects.‡

ORDERS OF SPECTRA.

After Lockyer.	After Ackroyd.	Metachromatic scale.
1st Order, Line spectra..... 2nd Order, Channelled-space spectra	Class I. Radiative.	
	Class II. Absorptive.	
	1.	
	Continuous absorption...	Black.
3rd Order, Continuous absorption at the blue end.	2. Partial absorption— *i.e.*, absorption at the blue and red ends, or at any intermediate part of the spectrum	Brown. Red. Orange. Yellow. Green. Blue.
4th Order, Continuous absorption at the red end.		
5th Order, Unique continuous absorption	3. Continuous spectrum ...	White.

Space will not allow of my going into the theory of metachromatism, and I would add, in conclusion, that those readers who are interested in its biological applications may consult the "Proceedings of the British Association for 1877," pp. 100-1, and "Science for All," vol. i., pp. 251-56.

* *Chemical News*, Sept. 8, 1876, p. 109.
† "Proceedings of the Royal Society," June 11, 1874.
‡ *Phil. Mag.* for December, 1876.

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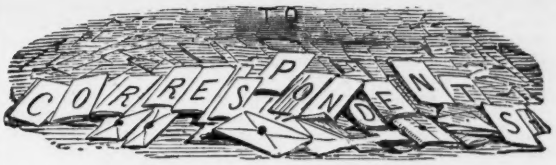

Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE: *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

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**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

CONSUMPTION FROM STAYS.

[576]—It appears to me that in his haste to denounce the editor of KNOWLEDGE (560), E. H. has omitted to read, with any care, my remarks of June 23 (431), which are the ostensible cause of his letter. I was well aware that, according to statistics, consumption was commoner among men than women, but I cannot see that I say in that letter that stays produce lung disease directly in the wearer.

What I said then, I say now, that they cause an external deformity, which many people, (E. H. probably among the number) are not ashamed to admire, forgetting that the corresponding internal deformity, which they do not see, produces a state of things incompatible with health and vigour, and that the children of women in this lowered state of constitution are more likely (as in the offspring of other deformed animals) to fall a prey to consumption and other diseases of that class which belong to feeble constitutions.

E. H. is partially right in what he says as to women being able to breathe higher up than men, but that only holds good as long as no exertion is made. Women engaged in hard work breathe much as men do, and I should like to see a woman walk up a hill, or run upstairs, without *requiring* the full use of her lungs. They do not generally get it, but that is not to the point.

What E. H. says about a particular state of health curing consumption, *on account of the difficulty of respiration*, will probably cause amusement to most of the readers of KNOWLEDGE. The fact as to the cure is so, but the reason is very different and too well known to need repeating here; besides, not being a doctor, it is hardly a subject the explanation of which I am qualified to enter upon.

We have not yet come fully to the end of the evil to the community of this system of "waists." It is only within the last twenty years that stays have been cheap enough for all classes to wear them, from the age of ten years old and upwards. Therefore, till lately, the nation was constantly recruited by the children of mothers whose bodies were of the shape that nature ordained. This is now being fast altered. How many people, for instance, realise the fact that 28 to 30 inches would be the size of the waist of a healthy woman of medium height when left to nature? In conclusion, might I suggest to E. H. to read Mr. Trèves' "Dress of the Period," published by the National Health Society, 44, Berners-street, and also a letter written by Dr. W. B. Carpenter, in the *Echo* of April 6 or 7, as he will there see what men who understand anatomy and disease think of waists.

F. W. HARBERTON.

THE TUBERCULOUS OR WARTY-SKINNED LIZARD.

(*Heloderma Horridum.*)

[577]—In reply to the paper on the "Heloderm," in KNOWLEDGE of Sept. 15, and in allusion to my own error in venturing a guess as to the meaning of its name, permit me to offer a word. In announcing the arrival of this venomous lizard in *Land and Water* of Aug. 5, I wrote:—"Conjecturally, *helo may* have reference to the sunny colour"; because, while having been verbally informed that this was the meaning of the word, I myself rather doubted it. Books have subsequently proved better instructors, and, on comparing the

XUM

descriptions given by various authors with the living animal, we see clearly that the definition of the word *heloderm*, as given in Knowledge, is the correct one—viz. from ἥλος, a nail, a wart, or stud, and δέρμα, the skin. In some other zoological terms, *helo* is similarly used to describe a warty or tuberculous tegument; as, for example, in entomology, *helophorus*, wart-bearing. One of this lizard's specific names is *hérissé*—"avec les écailles tubercules"—which, irrespective of colour, exactly describes the little prominences, like warts or knobs, with which its skin is covered. The arrangement of these warty plates is hexagonal on the back, but a little less regular on the sides and limbs.

And by reason of this rough, warty derm, would not the adjective *horridum* apply to the skin, and *not* to the animal, and therefore be correct in the neuter gender, to agree with *derma?* At first sight we naturally associate the "horrid" with the reptile; but it may be doubted whether Wiegmann did so in giving it the name; which is probably from *horridus*—rough, shaggy, rugged, &c. By the way, may not the *horridus*, as applied to the *crotalus*, be similarly explained, because this species has a particularly rough integument of dull, sharply carinated and deeply imbricated scales? This is merely conjecture, until I can consult the authorities.

Catherine C. Hopley.

ALCOHOL.

[578]—Adverting generally to your correspondence concerning the action of alcohol as food for the body after its physical powers are strained by mental labour, I should like to offer a few remarks with regard to "Mephisto's" letter (p. 250, No. 537) in particular.

"Mephisto" appears to mean that the action upon the human system, of fresh air, pure water, and moderate exercise is almost, if not quite, identical with that of alcohol. Can this be correct? I should think not. In the former case those elements are supplied, the use and consequent loss of which have caused the exhaustion. In the latter case the already wearied muscles and nerves are excited to further activity. Although a similar result is obtained in both instances, there is a most essential difference in the real state of the system. The physical feelings of a man who has recouped his exhausted energies with open-air exercise, and mental rest are widely removed from those of one who has stimulated his hard-worked faculties by the use of alcohol.

I am no "Blue Ribbonist," but I do think that there is no state of man where alcohol is really essential, except, perhaps, when one is habituated to its regular use. Chemical analysis shows little or nothing in the composition of alcohol that can be termed "food" either for brain or body.

I am a more humble, if not less enthusiastic, follower of the same pursuit that "Mephisto" makes his daily avocation. I also am engaged in purely "mental and literary" labour. In the study of science and scientific appliances I do an appreciable amount of brain-work. I read Knowledge not cursorily but with a view of extracting all the information from that valuable source I can, yet I never feel the need of alcohol, and, as I dislike the taste of it, I rarely touch it. I find I can retain sufficient energy for at least one day's consumption, and so can every man who is in really good health. I rise every morning with enough vital power to carry me well through the day, unless I am affected by abnormal causes, which I can always trace.

But of course, nothing *conclusive* can be deduced from individual experiences; and in conclusion, I would merely add, that if my friend "Mephisto" were to take a teetotal countryman from his pure air and healthy exercise, place him in one of our hard-working merchants' offices, and supplement his ordinary fare with the "alcoholic food" he proposes, I believe he would find in that countryman anything but a confirmation of his theory that alcohol really supplies, even in any degree, the place of fresh air and exercise.

Leonard P. Rees.

Letters in Type.—Size of Rising Moon, by G. E.; Local Weather Lore, by Michael Rearden; Singular Mental Illusion, by W. H. Perkins; Physiological Experiment, by Z.; The Use of Drunkenness, by J. Ralph; Talking Canary, &c., by Charles L. Cane; New Method of Preserving Organic Bodies, by W. Mattieu Williams; Defects of Bicycles, by John Browning and H. T. Round; Jordan-Glycerine Barometer, by C. J. W.; Dr. Hunter's Experiments, by Mathilde Van Eys; Monkey and Mirror, by Deo Fido; Coincidences, by A. R. W.; Lapidaries and Deception, by H. M. W.; Figure Training by Corsets, by Alfred Chadwick, M.D.

Errata.—No. 46, p. 258, second col., l. 44, for "ninety" read "forty-five." No. 47, p. 273, second col., l. 24, for "deterioration" read "determination."

Answers to Correspondents.

**** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* Knowledge, *the increasing circulation of which compels us to go to press early in the week.*

Hints to Correspondents.—1. *No questions asking for scientific information can be answered through the post.* 2 *Letters sent to the Editor for correspondents cannot be forwarded, nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

Ivy. There are no copies of Dr. Muir Howie's paper on the Effects of Tobacco in pamphlet form, but the numbers containing it may be obtained.—E. A. H. wishes to know if any competent reader of Knowledge can state if it is feasible, advantageous, or otherwise, to apply compressed air as a means of locomotion for private carriages.—R. B. R. I can see no reason why a rainbow should not be seen by reflection at the surface of water.—C. Browne. Try Mr. Grant Allen's "Evolutionist at Large."—D. Phillips mentions that Normandy's "Commercial Handbook of Chemical Analysis" is a standard work on the subject (Crosby. Lockwood & Co.), 12s. or 12s. 6d.—C. J. Brown. Mr. Allinson certainly erred in saying the air contains more moisture in cold weather than in hot, the reverse being the case (on the average). He doubtless meant that usually in cold weather the air is more nearly saturated with moisture.—R. F. Waugh. The weather predictions are simply "bosh"—nothing. It would be "impossible" to consider all that correspondents say. Still, I have had useful hints; and one can fairly judge, from a preponderating majority, what is best for readers.—A. H. Swinton. According to my present lights I can do nothing to encourage any such publication.—A. H. W. Many thanks for your kindly and encouraging letter.—W. Probyn Nevins. According to the Darwinian theory there is no thinking in the matter. At some remote period, members of that family of lizards had a better chance of escaping their enemies the quieter they were when enemies were near. Thus more and more of the livelier perished, and by this process of natural selection of the quieter ones for breeding the race became more and more quiet in times of danger, until at length the present peculiarity was fully evolved.—J. H. A. Jenner notes that in letter 533, about Fairy Rings, in lines 15 and 16 the word "uppermest" should be "outermost."—E. F. B. Harston. Mr. Stradling evidently did not put very full faith in the snake story. There are, as you say, certain idiots who find a joke in inventing stories of the kind, that they may laugh at those who receive the stories. If they knew the utter contempt in which men of sense hold them, they would probably turn their ingenuity to something more profitable—as starting bogus companies, selling adulterated food, or other swindling. The startling theory that the equator is moving north is one of their stories. A change which would not be detected in a hundred years by the rough method described would be as obvious as the sun in the sky to astronomical observation.—Chemicus suggests that fermentation may be akin to that Catalytic action of which a theory was propounded by Berzelius. The "living germs" theory seems, however, demonstrated by the evidence.—D. Stewart. Your thinking of a "bear," and the lady saying a "bear" when you asked her to name an animal, was good evidence in favour of thought-reading. But "fuchsia" for "geranium" was not so well. I have just tried the experiment. I thought hard about the "geranium," and the flower unkindly selected by the lady experimented on ("wife of mine, in point of fact," as Mr. Dorrit, jun., might have said) was a "buttercup." I thought of an animal, the "bear," and her mind was forcibly impressed with the idea of a "giraffe." I next tried the "cow," and she could think of nothing but a "lion." After this, I concluded that either thought-ruling was not *my* "fort," as Artemus Ward puts it, or thought-reading was not *hers*. Yet in ordinary life we repeatedly anticipate each other's thoughts.—M. O'Connor. The writer of that review ought to receive £1,000,000 multiplied by 0+2.—D. T. Buller. Yes; that would now be thought very moderate dispersion for a 64½° prism. But in Newton's time glass prisms could only have been made of very inferior glass.—M. H. Close. After what has been already said on the subject (which you either entirely misapprehend or else you are attempting a feeble joke), I find nothing to say about your letter but that your definition of the word "moment" is entirely wrong. That is one use of the word, but not its primary use. See an admirable article (undoubtedly by De Morgan) on the subject under head "Momentum," or "Moment," in the *Penny Cyclopædia*.—E. C. R. See letter from Mr. M. Williams, shortly.—G. St. Clair. (1) Ditto; (2) Nothing can be inferred on these points from a single observation of a comet, and the photograph is equivalent to that.—C. H. Romanes. We keep over your letter for a while. Could you not

send a sketch, however rough, showing how the pipe and flap are situated?—P. H. M. wishes to know how best to polish stones for geological specimens.—W. H. S. Taking your postscript first, in which you express some anxiety lest I should "sit upon" your letter, my answer must be akin to that of the Cherubs, when the polite French saint on whom they had called said, "*Asseyez-vous, messieurs.*" "*Nous n'avons pas de quoi, monsieur,*" was their reply. In like manner I find nothing to sit upon in your letter; on the contrary, I find it very kindly, courteous, and considerate. The difficulty about supplements on special subjects is that they would have to be high-priced, as the number of specialists is small. From a rough calculation I find that for a thousand astronomical readers a supplement of 16 pp. would have to be priced at 4d. at least. After all, the purpose of KNOWLEDGE is rather to encourage general than special study of science. We want our specially astronomical readers to enjoy our papers on subjects botanical, zoological, electrical, chemical, &c., and so with other subjects. I suppose the professed botanist would hardly expect to learn much that was new to him from one of Mr. Grant Allen's charming papers, though I hope (for his own sake) that his special study of botany would not deprive those papers of the charm which they have for those who, like myself, have only a general knowledge about botanical matters. So again, though I hope that professed students of astronomy may find something to interest them in my lighter essays on astronomical matters, I do not write for them, but to interest, as far as I can, those who are not astronomers.—J. H. COBBETT (representing four others), L. K. MOORSOM, R. PROTHERO, FINE WEATHER, MEAGLES, H. H. TAYLOR, and others, in great number decide against the Weather Charts; JAS. WILSON, JUN., M. HARTINGTON, and a few others, like the charts, but are not disposed to insist on them; METEOROLOGIST must have them. "Must he?" If the majority decide against them, "let him not hope to have them."—M. R. I really must set that Top Spinning. (No occasion to explain that you "did not mean your severity." I read "fun" in the first line. "Cupidus Cognoscere" is referred by M. R. to Ferguson's Select Mechanical Exercises.—B. M. Well, I must confess I think with Tyndall and Huxley that many anti-Vivisectionists are *fanatics*. But who ever called them "bestial"? "Bestiarian" is a very different thing; it is a term no anti-Vivisectionist should be ashamed to accept. In fact, moderate as my own views are, I should call myself a Bestiarian in Owen's sense. You think I do myself injustice in saying that I have nothing to do with the atrocities of some Continental Vivisectionists. Would you think, if I said I had nothing to do with atrocities described in the daily papers, that I should be suspected of applauding them?—NEWTON CROSLAND. Hampden and Parallax no more consider their arguments refuted than you judge yours to be. I fear the distinction you draw between yourself and others of the heterodox is not generally recognised.—KERRY RIX. Such suggestions as yours (and so made), are really useful to an editor. I think the subject you name (spectroscopic analysis), one which specially requires treatment in such a journal as this. I thank you, and by no means complain as of the grumbling few.—A CRITIC. *All* egotism is silly. Why pile up epithets? One would almost imagine you were angry! Now, you are not egotistic; for you write rude things, on a post-card, anonymously; which means that you would rather know yourself contemptible than be so known to others. Being altogether above egotism, you should only pity, not abuse, those who still have some respect left for themselves. Not every one can go, as you do, beyond Mawworm, who only liked to be despised, whereas you evidently like to despise yourself. For portrait, see *Punch*, p. 123, current vol.—EBEN. JONES. Transit of Venus now fairly begun. Agree with you about the weather Charts; but if you only knew how we were entreated to have them, you would understand.—F. C. I trust the dyspepsia for which you want a remedy has not been *caused* by your "reading our answers to correspondents this last six months." By-the-way, I see it was not, as you go on to mention that it has lasted eighteen months. I doubt if even our medical contributors would venture to suggest a remedy for an ailment of such long standing, without much fuller particulars, and seeing you personally.—E. H. LEENEY, H. J. WATSON, A. J. Cannot drop either Whist or Chess.—W. C. THOMAS. Many readers want the smaller type to be all but wholly disused.

ELECTRICAL.

Z. Y. X., thinking it may interest our readers, has kindly sent to say that while in Brighton a few weeks ago there was exhibiting there "an electric boy; he gives an electric shock to anyone who touches him, and walks about so that he can be examined. The exhibitors state that he was born in Australia, of English parents, and has been exhibited there, as well as in New Zealand and the United States; that he began to show extraordinary electrical powers after his fifth year, which increased with his age; that he had good health and wonderful curative powers in cases of neuralgia, rheumatism, and headache." I do not remember having seen or heard anything of this marvel, and should be very careful to ascertain that there was actually no deception being attempted. Such a thing might easily be done. I should like to hear more of this.—HENRY MACEWEN. Urquhart's "Electric Light" is published by Messrs. Crosby, Lockwood, and Co. It does not give much of the information you require, but his "Electrical Engineering" will doubtless supply it. The book, however, is not yet published.—HENRY EDMONDS, saying that he knows nothing of electricity, asks for the name of a good initiatory text-book. I am afraid that unless he has the means of seeing or working experiments, his progress will be more apparent than real. He cannot do better than start with Angell's "Electricity" (Collins' series) and Deschanel's "Electricity and Magnetism."—C. R. In practice the terms "intensity" and "quantity" are still, and will doubtless for some time continue to be, freely used. The names or terms may be in themselves "remnants of an erroneous theory" concerning the nature and propagation of electricity, but they have still the same significance as regards the properties, or working capacities, of a current. The term "intensity" is synonymous with "Electro-motive force" and "quantity" with "current-strength." The question is being more fully dealt with in the articles on "Electrical Measurement" (see KNOWLEDGE, Nos. 40 and 41), and I think a perusal of them will be much more efficacious than a restricted answer to a query could possibly be. Reference might also be made to previous "answers" appearing in previous Nos.

LETTERS RECEIVED.—G. Carid.—H. F.—C. Francis.—W. Davies.—E. R. Cowley.—T. P.—A. Stradling.—Pleni Almoni.—E. P. W.—A. N. S.—Hack.—W. B. Bishop.—X. Z.—Bryum.—A Perplexed Student.—H. H. French.—S. Lawther.—W. Moon.—Abstainer.—Stanley Baldwin.—W. S.—Leander.—No Alcohol.—Z. Y. X.—Iota.—J. Glover.—J. Watson.—Yale Yrneh Ruhtra.—C. C. C. C.—J. Fraser.—E. Holloway.—G. Henslow.—C. H. Romanes.—E. D.—A. Gorham.—W. N. Bell.—E. S. B.—J. M. G.—J. A. Ollard.—G. Kamensky.—Sufferer.—Indicus.—W. Hicks.—A. R. Woods.—T. D. N. M.—A. Bray.—M. B. A.—Mangler.—H. McKendrich.—G. Glasgow.—C. J. Eve.—C. Pool.—J. Huddlestone.—W. H. Ruth.—H. A. Bulley.—L. R. L.—M. A. Close.—A. W. D.—H. M.—W. P. H.—A. A. Murdoch.—J. B.—F. Lobritz.—J. J. Rostri.—J. S.—R. Leigh.—B. M.—A. P. S.—Hallyard. Others received since Monday.

EUROPEAN POSTAGE.—A recent article in the *Deutsche Industrie Zeitung*, on the European postal traffic of 1880, shows that the total number of articles sent was 6,206,577,592. Letters and postal cards were in the proportion of 61·3 per cent.; newspapers, 22·9; book-packets and patterns, 15·8. England was first, with 27·2 per cent. of the whole; Germany second, with 23·3 per cent.; France third, with 19·6 per cent. Nearly everywhere there is an increase of letters and postal cards per head of the population. An estimate shows that in England each inhabitant allows ten days between two letters; in Switzerland, two weeks; in Germany, twenty days; in Russia, two hundred and eighty days; in Bulgaria, about three years. There were 55,479 post-offices in 1880, an average of one to every 5,859·9 inhabitants. The *employés* numbered 250,665. The postal traffic has increased 58·8 per cent. in eight years, and in the whole of Europe the surplus is about $27,000,000.

INFLUENCE OF COERCIVE FORCE ON THE HEAT PRODUCED BY MAGNETISATION.—Mr. L. Pilleux has made some experiments from which he concludes that magnetisation produces great heat in paramagnetic metals. In order to obtain a marked effect, he magnetised and demagnetised iron and steel cores at short intervals by means of a De Mériten's alternate current machine. In this way he succeeded in raising the temperature of an iron core to at least 300° C. He states that a piece of pure tin brought into contact with the heated core melted instantaneously. Replacing the iron core by cores of copper, brass, and tin, Mr. Pilleux found that their temperature remained unaltered. Using a steel core, he found the heat considerably greater than in the case of the iron core. In the case of a very soft iron core the temperature was still less, and when using a core consisting of a bundle of very soft iron wire the temperature showed a further decrease. From his experiments Mr. Pilleux concluded, first, that the heating of the cores of electro-magnets must be attributed to magnetisation and not to induced currents; and second, that the coercive force of the cores increases their propensity for becoming heated in the same manner as the resistance of a wire causes its temperature to be raised by the passage of an electric current through it.—*La Lumière Electrique.*

XUM

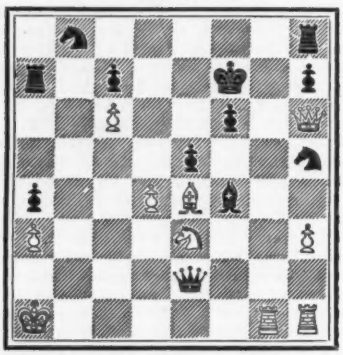
Our Chess Column.

By Mephisto.

PROBLEM NO. 55.

End Position from actual Play, by Leonard P. Rees.

Black.



White.

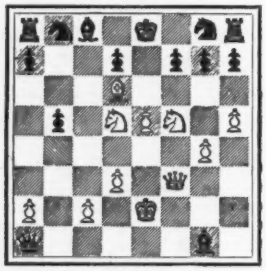
White to play and win.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess-Editor.*

J. Duncans.—If in the game on p. 270 Black had played 20. B to R3, instead of Kt to R3, the game would probably have resulted in a draw, *i.e.* :—

Black.



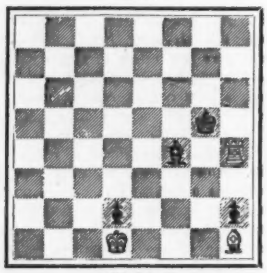
White.

	20. B to QR3
21. Kt to B7 (ch) (best)	21. K to Q sq
22. Q takes R	22. Q to B6
23. Kt takes B	23. Q takes BP (ch)
24. K to K sq	24. Q to B8 (ch)
25. K to K2	25. Q to B7 (ch) and draws

by perpetual check. Should Black attempt to defend by Q to B sq, he will lose by B to B7 (ch), K to Q sq, and then Kt to Q6 (ch) winning the Queen. Again, White cannot play any other move, for if K to B sq he will be mated, or if K to B3 he will lose his own Queen by Black playing Q to KB7 (ch), K to K4, then Q to KKt7 (ch), winning the Queen.

G. G. R.—In the following position White can win by proper

Black.



White.

play. He must, however, exercise proper caution, and never leave the dangerous Pawns out of sight.

1. R to R	1. K to Kt5
2. K to K2	2. K to Kt4 (or a)
3. B to B3	3. K to B4
4. K to Q3	4. K to Kt4
5. K to K4	5. B to B2
6. R to R5 (ch)	6. K to Kt3
7. K to K3.	

White now wins this Pawn and will be at liberty to proceed more vigorously against the Black King, the object being to bring him on to the eighth file. Play is very complicated and difficult; the Bishop must never leave the diagonal commanding the Rook's square, and yet he will be somewhat made use of for the attack. Play might proceed as follows :—

7. B to Kt sq; 8. K takes P, B to B2; 9. K to K3, B to Kt sq; 10. K to K4, B to B2; 11. K to Q5, B to Kt sq; 12. K to K6, B to B2; 13. R to QB5, B to B5; 14. B to K4 (ch), K to R3; 15. K to B7, B to K6; 16. R to KB5, B to Q7; 17. B to B3, B to KKt4; 18. R to Q4. Black now cannot play his Bishop, for White threatens R to R5 mate. Black is, therefore, compelled to play P to R8, and after White playing B takes P he will easily be able to win. Of course, both White and Black might play differently, but the above variations show the principle on which play should proceed. If 2. K to Kt6. 3. R to Kt8 (ch), K to R6. 4 B to B3 and White wins the Pawn; for if K to R5, then R to Kt4, or if B to R3, then R to R8. By combined manœuvring of Rook, Bishop, and King, White will always succeed in winning first one of the Pawns and then driving the Black King to the edge of the board.

Squire.—You omitted to give your address.

W. Mead.—The game shall be withheld as you desire.

Squire, John O'Keeffe, T. T. Dorrington.—In Problem 54 if 1. Kt to Kt4 (ch), K to Kt4. 2. Q to KR5, P to B7 and there is no mate.

Novice.—1. Q to B sq, P to Q3 and there is no mate in two moves.

Solutions received of No. 51 by A. J. H., Kit, W. C. Thomas, Blackie. No. 52, Blackie, W. C. Thomas, Kit, Harold Jacobs, Agnes Larkcom, Evelyn. No. 53, Agnes Larkcom, Harold Jacobs, Kit, Evelyn.

Problem No. 54 correctly solved by H. Seward, G. W.

C. W. Stuart *v.* A. Johnson.

R. Pilkington *v.* John O'Keeffe.

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